University of Alberta

Consumer Behaviour: Who Seeks Information about Genetically Modified Foods?

by

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A thesis submitted to the Faculty of Graduate Studies and Research in partial fulfillment of the

requirements for the degree of Master of Science

in

Agricultural and Resource Economics

Department of Rural Economy

Edmonton, Alberta

Spring 2005

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ABSTRACT

This paper reports on a sample of consumers' voluntary search for information on genetically modified (GM) foods. In the course of a computer-based survey on consumer choices of bread, some 445 respondents are randomly assigned to different information scenarios, which involve voluntary access to information (this is accessed through a "mouse click"). The "mouse click" data show that slightly less than 50% of the respondents actually sought the information made available on GM technology and related issues, while the remainder did not.

The economic benefit-cost structure is adopted as the theoretical basis for our study. As well non-economic factors are introduced as constructs that may influence information search. The findings of this study should contribute to a better understanding of why some people search for information on GM food and provide information that may aid understanding of effective risk communication to consumers and public policy makers.

ACKNOWLEDGEMENTS

I would like to thank Dr. Michele Veeman and Dr. Vic Adamowicz for their valuable advice, guidance and dedication. Their always patient and accessible counsel led to the successful completion of this thesis. I would also like to thank the committee member, Dr. Wendy Wismer, for her suggestions that improved the quality of my thesis.

Special thanks to the academic and administrative staff of the Department of Rural Economy.

I would also like to thank my friends and colleagues who have been always there helping me and cheering me up while I was in this program.

Most importantly, I would like to thank my husband, my parents and my sister. Without their support, it would not be possible for me to finish my program smoothly. Special thanks to my husband, who has been with me for the past three years of our life in Canada, loving me, supporting me and helping me out whenever I feel down. Despite the distance, I continue to receive love from my parents and sister. They let me know what great love is between parents and child and between siblings. Thanks a lot for my parents' consistent wise guidance and encouragement. I dedicate this thesis to all of them.

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1 INTRODUCTION

1.1 Background

Genetically Modified (GM) technology and products are still viewed as controversial by members of the public even though some time has passed since the first appearance of GM food products in 1994[1]. People may differ in their understanding and perceptions of GM food technology and products. On the one hand, proponents advocate potential benefits of GM technology, like improved food quality, increased productivity, and environmental benefits from reduced chemical use (pesticide and herbicide use). On the other hand, those who strongly oppose the technology are sceptical about the possible results of the application of GM technology on crops and animals, and are concerned about possible uncertain, long-term effects on human health and the environment. Overall, important ethical and moral issues of GM food still remain unsolved (Hu et al., 2004). Since there are a variety of opinions and disagreements on GM food, it is of interest to know whether and why consumers access information on GM products. This is the focus of this thesis. Further issues of interest are how such information is processed and the effect of information on consumers' preferences for food, but these issues are outside the scope of this study.

The present study tries to explain consumers' information search behaviour associated with GM technology and products. In particular, we analyse underlying factors that may have an influence on or lead consumers to search for more information on GM food in a specific situation. In a recent national assessment of consumers' perceptions and stated choices concerning genetically modified food, which made

[1] The first genetically modified food to be approved for commercialization was the FlavrSavrTM tomato, which entered the global agri-food system in 1994 (Phillips and Corkindale, 2002)

additional product information voluntarily available to consumers through an on-line survey, it was found that less than 50% (47%) of 445 participants voluntarily accessed product-related information made available in the course of the experiment. The remaining 53% did not seek out information (Hu et al., 2004). This thesis examines this issue and attempts to explain why individuals accessed information in the context of this experiment.

Information is an important input to the consumer decision- making process, and information search has been regarded as a critical component of consumer purchase behaviour. Comprehensive theories of consumer decision processes have long recognized the importance of this component and incorporated this as a construct in modeling the decision processes (Punj and Staelin, 1983). Information shapes consumer perceptions and attitudes toward a product and may influence consumer purchase preferences for that product. There is a long history of research studying consumers' information search behaviour, especially in the field of marketing, and this is still a topical current issue.

From the perspective of the discipline of economics, a theoretical basis for information search analysis is provided by Stigler (Stigler, 1961) through the economics of information (EOI). Despite some limitations, this theory has provided a basis for economists to analyse consumer information seeking behaviour in marketing and other fields related to economics. In this theoretical framework, consumer information search behaviour is analysed through the economic concepts of benefits and costs. Researchers in marketing have cited Stigler's framework regularly, using this as an intuitive description of consumer search behaviour (Goldman and Johansson, 1978).

However, the EOI approach has been criticized as inadequate by some authors, on both theoretical and empirical grounds. These criticisms are based on the argument that relatively little information search behaviour can be explained by the EOI approach (Goldman and Johansson, 1978; Urbany, 1986; Maute and Forrester Jr., 1991; Avery, 1996). The deficiencies of the EOI in explaining consumer information search arise mainly from its isolation from the psychological and sociological perspectives on consumer information search behaviour. Stigler's theoretical framework is nonetheless still of importance and is used as one of the bases of this study. Justifications and modifications are, however, made to the EOI framework to avoid its shortcomings. Furthermore, this study also draws from research on consumers' attitudes and perceptions toward GM food (Frewer et al., 1998), risk perception and communication (Frewer, 2000) and the role of trust in information sources (Hunt and Frewer, 2001).

1.2 Research Objectives

This study focuses on consumer search behaviour relative to information on GM food in terms of determining who will search for this kind of information and why. To be specific, we try to explain relationships between consumers' attitudinal, perceptional and socio-demographic characteristics and a particular information search activity. In order to fulfil these goals, we try to find answers to the following two questions:

1) Who searches for information on the genetic modification (GM), health and environmental attributes of the product?

2) What drives consumers to seek information?

To answer the first question, we need to analyze a respondent's characteristics that may include socio-economic information, such as gender, age, income, education

level, place of residence, and family situation. Along with this type of information, we will consider whether respondents' knowledge of GM technology, previous experience with GM food, as well as their attitudes and perceptions toward GM products help answer the two questions at issue. In considering the factors that lead consumers to seek information, we assume that this is based on economic principles. That is, we assume that consumers are rational in a bounded sense, so that relative to a particular behaviour, the trade-offs between the benefits of information search and the costs of information search should be considered. Following this theme, we establish our theoretical framework based on Stigler's benefit-cost theoretical structure. Stigler's work is focused on consumers' information search behaviour on lowest prices of homogeneous products, thus we adapt this to consider constructs that seem appropriate to reflect the benefits and costs that GM information search can bring to consumers.

Understanding how consumers acquire information is important at the micro level for marketing management decisions and at the macro level for public policy decisions (Srinivasan, 1990). Marketing managers need to understand information search determinants and design effective marketing communication campaigns because "Information search represents the primary stage at which marketing can provide information and influence consumers' decisions" (Schmidt and Spreng, 1996; Wilkie and Dickson, 1985). At the same time, a better understanding of how consumers seek and obtain information should also help public policymakers to improve the quality and accessibility of information.

Given the concerns of numbers of consumers about food safety and food quality issues that might be associated with genetic modification technology, and the lack of

knowledge of the public's perceptions and attitudes toward genetically modified food products, it is hoped that this study will contribute knowledge on the process of information search by Canadian food consumers. This should be of interest to policy makers, as well as Canadian consumers, since both are interested in effective risk communication. Few if any previous studies have focused on consumer information search behaviour toward genetically modified food.

1.3 Organisation of the Thesis

The next chapter presents a review of literature that relates to the research problem. In this review, Stigler's economics of information (EOI), which has been regarded as a milestone of economic theory on information search, is introduced. Assessments that support this theory and that disagree with it are also presented. Based on these arguments, a theoretical framework, which is presented in Chapter Three, is constructed. The source and nature of the data that are analysed in this study are outlined in Chapter Four. In this chapter an overview to the survey through which these data were collected is provided and some general characteristics of the data are introduced. The model development and estimation results from regression analysis are described in the fifth chapter. Since complexity in decision-making and choices may be an important influence on discrete choice behaviour, in Chapter Six, the effect of choice context on consumer information search is examined and estimation results relating to this are interpreted. In the last chapter, the findings of the study are summarized, policy implications are presented, and future research possibilities in the area are outlined.

2 LITERATURE REVIEW

2.1 External Search

As Beatty and Smith have stated relative to (price) information, search behaviour is "the degree of attention, perception, and effort directed toward obtaining environmental information associated with consumption-related objects, regardless of whether the consumption objects are related to a specific purchase under consideration." (Beatty and Smith, 1987)(p.85). A similar but more general definition was given by Srinivasan and Ratchford as "the efforts aimed at acquiring information from the external environment" (Srinivasan and Ratchford, 1991)(p.235), which, compared with the previous Beatty and Smith definition, is relatively comprehensive, rather than being associated with consumption-related objects relative to specific purchase behaviour. This type of search has been called "ongoing search" (Bloch et al., 1986). Even though pre-purchase search and ongoing search are different in concept, they "are difficult to separate in practice" (Bloch et al., 1986)(p.120). Although the purposes of pre-purchase and ongoing search may be different, the difference involved in these activities would hardly be distinguishable by an outside observer (Bloch et al., 1986). According to Newman, search activity increases when the consumer believes that the purchase is important, there is a need to learn more and the consumer is stimulated to obtain and use information (Newman, 1977).

The usage of the term "external search" (rather than "search"), recognises that external search activity is not the only method by which consumers obtain relevant product-related and shopping information. The alternate method, which is usually much less costly in terms of effort, can be obtained from scanning long-term memory, an

internal search process. Any attempt to quantify the internal search process requires very "fine-grained" process-tracing methods (Punj and Staelin, 1983). In our study, we focus only on external information search.

2.2 Stigler's Theory of the Economics of Information

2.2.1 Overview of Stigler's theory

One of the enduring interests in consumer behaviour is the investigation of external information search. In the context of information about prices and product quality, which have been the focus of economic literature on information search, it is recognised that consumers generally have very imperfect information about the prices charged for the same product by different retail stores, and often know little about the qualities of the products and services available in the marketplace. Stigler analysed this issue by developing a systematic theory of the rational search for market information by imperfectly informed participants (Becker, 1993). In this analysis, Stigler defined consumers' market search behaviour as the activities to obtain the most favourable price or higher product quality with incomplete price information (Telser, 1973). Incomplete price information results from the characteristics displayed by markets of a "frequency distribution of prices" (Avery, 1996). In such markets, no buyer (or seller) has complete information about the price distribution. In order to obtain product and price information, buyers have to undertake search activities at some cost. Since search is usually costly, Stigler argued that "If the cost of search is equated to its expected marginal return, the optimum amount of search will be found" (Stigler, 1961)(p.216). This hypothesis has been interpreted as the principle that people search for information as long as the marginal benefits outweigh the marginal costs of the search (Goldman and Johansson,

1978). The costs of search are, according to Stigler, the resources invested in the search process, which are composed of two elements: time invested in the search and the monetary expenditure on search activities and consumer effort expended in applying cognitive ability to the task of search. At the same time, search behaviour is also viewed to provide benefits to the consumer in terms of either lower prices or higher product quality. On the basis of these assumptions, the amount of search undertaken by the consumer is predicted to be negatively related to the costs of the search, and positively related to the benefits from the search.

In Stigler's analysis, emphasis was put on the buyers' identification of sellers and the discovery of their prices, with qualitative information on the product intentionally avoided. Stigler justified this neglect on the basis that search for knowledge on the quality of goods may not be of importance and that quality had not yet been successfully identified by economics (Stigler, 1961).

2.2.2 Related studies and criticisms

Stigler's theoretical framework has frequently been adopted by economic researchers as a basis to explain consumer information search behaviour on different subjects (e.g., Duncan and Olshavsky, 1982). Another important researcher in the study of consumer information search behaviour is L.G. Telser, who used similar methods to analyse consumers' search for information on the lowest price by a series of experiments that were based on hypotheses of consumers' knowing, and not knowing, the price distribution. In Telser's study, it was proposed that consumers minimized the expected value of the loss caused by search as well as maximizing the gains from the search. These were determined by the factors of "the shape of the price distribution", "the

marginal cost of search" and "the searcher's prior knowledge about the price distribution" (Telser, 1973). However, Telser also recognised the limitations of considering consumers' information search behaviour only as a monetary cost-benefit concept. Overall, the contribution of the EOI to the study of consumer information search behaviour is recognised, as in Urbany's (1982) conclusion that search behaviour is a complex process and would not be predicable or interpretable without considering the interactions between the costs and benefits of search.

Over time more researchers have criticised the feasibility and applicability of EOI theory on both theoretical and empirical grounds. It has been argued that the approach is inadequate since relatively little information search behaviour has been explained by this approach (Goldman and Johansson, 1978). It has also been argued that EOI theory has not arisen from the direct study of the search behaviour of consumers and does not accurately describe such behaviour (Goldman and Johansson, 1978; Urbany, 1986; Maute and Forrester Jr., 1991; Avery, 1996).

In reviewing literature on the determinants of information search for lower prices, Goldman and Johansson argued that the use of Economics of Information (EOI) in the study of consumer search behaviour was limited and had been adopted mainly to analyse various aspects of market structure rather than to direct studies of consumers' information search behaviour (Goldman and Johansson, 1978). Goldman and Johansson argued that other perspectives should be explored, especially under circumstances where the monetary savings from search are rather small, since non-economic perspectives apparently provide more powerful explanations of information search in these situations (Goldman and Johansson, 1978).

It was noted by Bettman that most studies of consumer choice behaviour have examined correlates of search activity rather than theorizing and measuring the causes or motivators of search behaviour (Bettman,1979). It was proposed that involvement could be a practicable motivational construct that had not been empirically linked to external search behaviour (Bettman,1979; Beatty and Smith, 1987). Advocating the idea of adoption of involvement as a factor to explain consumer information search and previous conceptualizations of involvement, Beatty and Smith (1989) suggested that such dimensions as product class knowledge, time availability, and attitudes toward shopping, could be useful in explaining external search effort.

In a study by Avery (1996) on determinants of search for frequently purchased, nondurable grocery items, the limitations of EOI were also discussed. Avery argued that one limitation of Stigler's theory of information search was that it did not explicitly incorporate non-economic factors such as involvement-based motives that had been identified in other disciplines as having a major impact on search (Avery, 1996). Another limitation of the theory was proposed to be the ambiguity of its theoretical predictions in less structured purchased decisions, like in the purchase of commodities with lower purchase frequencies, and particularly for less expensive and non-durable goods. Punj and Staelin suggested that other factors, unique to a consumer, could help explain information behaviour besides search benefits and costs. These could be factors such as "the desire to seek information", "prior memory structure", and "previous product information" (Punj and Staelin, 1983). In this line, Just has argued that mainstream economic models do not incorporate the structural role of consumer perceptions (Just, 2001). This deficiency also exists in Stigler's theory of Economics of Information.

It has also been argued by Maute and Forrester Jr. that the characteristics by which information is produced and disseminated as a commodity imply that a simple marginal benefit/cost model may not be adequate to explain the market for information. One of the characteristics of information is that "consumer perceptions of search benefits and costs are affected by seller distribution of 'free' information in the form of advertising" (Maute and Forrester Jr., 1991), p.644). Another characteristic of information is "because consumers understand that the purpose of advertising is to persuade as well as to inform, they discount the value of this 'biased' information and seek to verify its authenticity" (Maute and Forrester Jr., 1991), p. 644).

Noussair and his colleagues studied discrepancies between European public opinion and consumer purchase behaviour with regard to genetically modified organisms in the food supply (Noussair et al., 2002). In three sessions of his experimental auction, the subjects accessed a sample food product offered with different levels of information: the first session gave no packaging or labelling of the product (a chocolate bar); the second session gave the original labelling of the product (which indicated GM ingredients) and third session provided magnified projected labelling information. Vickrey auctions were adopted after each of these information sessions to examine the subjects' willingness-to-pay for the product. Between sessions 1 and 2, the bids offered by subjects did not change much, but these changed dramatically after session 3. The experimental results suggested that these consumers did not always read labels and that being aware of the fact that a food product contains GMO would have a considerable effect on consumer purchase behaviour. (Noussair et al., 2002).

2.3 Determinants that Influence Consumer Information Search Behaviour

As discussed above, in Stigler's approach, the constructs that may influence consumer information search were chosen, only from an economic perspective, in the context of benefit-cost structure and analysis. Since in this approach the search behaviour was targeted to obtain lower prices of a homogeneous product, the determinants of search in any particular analysis would generally be chosen from two main categories: gains from search and costs of search (Telser, 1973; Goldman and Johansson, 1978). In the category of *gains from search*, factors that have been included in previous studies included people's expenditure on products, their repetition of purchases, amount purchased, perceived price dispersion, and so on. Opportunity costs of time, direct monetary search costs, and measures of search efficiency are among the most frequently adopted variables to represent costs of search.

In subsequent research on consumer search for information, some authors have continued to consider information search within the economic concepts of a cost-benefit structure of search, but in contrast to analyses by Stiger and Telser, factors from other perspectives have been incorporated into these studies. Punj and Staelin (1983) adopted a dichotomous structure to explain consumer information search on new automobiles. In their model, five constructs were defined to explain consumer information search and at the same time the constructs were postulated to be explained by a function of related antecedent variables. In addition to the "cost of external search", the other four constructs were "usable prior information", "prior memory structure", "desire to seek information" and "effectiveness of search", none of which have a close tie with the benefit-cost framework and were taken to reflect factors unique to each consumer. For

example, one chosen construct was "usable prior information", which was postulated to be a function of three explanatory factors that were related to the consumer's experience with the product class or with the purchase task: "previous satisfaction", "time since last purchase", and "total purchases" (Punj and Staelin, 1983), p. 370).

In a review by Srinivasan of consumer information search literature, three major theoretical streams within this literature were identified and summarized (Srinivasan, 1990). The first stream, called the psychological/ motivational approach, incorporates individual-, product class-, and task-related variables to explain consumers' motivations for search. The second approach noted by Srinivasan is the economic approach, which uses the framework of cost-benefit concepts to study information search. The third is termed the consumer information processing approach, which focuses on consumers' memory and cognitive information processing activities. Since it is believed that the psychological/ motivational perspective includes information processing theory, the former involves both motivation (which is what Srinivasan primarily discusses in his "Psychological Approach" section) and ability (which would fall into Srinivasan's "Information Processing" section). The first and third theoretical streams highlighted unique consumer characteristics and were viewed by Srinivasan to be of equal importance in information search to the benefit-cost structure from the second stream. Overall, Srinivasan (1990) maintains that the two important issues in the study of consumer information search are the unique consumer characteristics and the economic benefit-cost structure.

In a subsequent overview, Srinivasan and Ratchford further summarized previous research in determinants of consumer search into the following categories: aspects of the

information search environment (e.g., the difficulty of the choice task, number of alternatives, complexity of the alternatives), situational variables (e.g., previous satisfaction, time constraints, perceived risk), and consumer characteristics (e.g., education, prior knowledge, involvement) (Srinivasan and Ratchford, 1991). These authors emphasized the role of environmental and situational variables as well as consumer characteristics.

Schmidt and Spreng in 1996 developed a model of information based on four antecedents postulated to be important to information search: ability, motivation, costs and benefits, claiming this to be relatively parsimonious (Schmidt and Spreng, 1996). The four identified factors were seen by Schmidt and Spreng as being based on two well-established theoretical perspectives of external information search: the psychological information processing approach and the economics perspective. It has also been argued that the relationship between determinants of consumer information search and search behaviour itself may be positive, negative or independent, and that specific types of relationships could be non-linear, such as a U- or inverted U-shape (Kiel and Layton, 1981).

The theoretical model we propose in the next chapter attempts to build on previous literature. Previous research mainly focused on consumer information search behaviour on experience and search attributes of products, like price. In contrast, our study deals with a specific type of information search about credence attributes of a product (including the GM attribute of a product). The broad focus of a benefit-cost structure, as proposed by Stigler, is adopted as a major basis of our model and proxies of the effect of perceived risk on benefit of search are considered. As well the concepts of

the benefits and costs of information search are expanded to include non-economic factors such as unique consumer characteristics as constructs that may influence information search. Situational and environmental variables are possible considerations in the study.

3 THE MODEL

3.1 Theoretical Model

On the basis of the reviews and discussions above, we propose a model of information search based in principle on the benefit/cost structure of the search for information (Stigler, 1961; Telser, 1973), but include in this framework individual-specific socio-economic factors that may affect individual's assessments of these benefits and costs, derived from perspectives of sociology and psychology. We assume that consumers seek information in order to increase utility, in order to make a more satisfying purchase decision. In the context of this study we hypothesize that consumers may seek GM-related information to reduce or avoid possible costs/ risks to their health or to the environment, or for ethical or social reasons. We postulate three groups of constructs that may impact on consumers' information search behaviour. Our theoretical model of information search is shown in Figure 3-1, which depicts whether a consumer conducts an information search activity or not, as the terminal construct of the model. The figure graphically indicates that three groups of constructs are postulated to determine the occurrence of the search event. The first group represents the costs of conducting the search, while the second reflects the benefits of search, which in combination reflect the cost-benefit structure approach to information that was proposed by Stigler and has been applied by numerous authors (e.g., Duncan and Olshavsky, 1982; Srinivasan and Ratchford, 1991; Punj and Staelin, 1983). The third group of factors that are proposed as determinants of search behaviour are specific consumer characteristics, referring to the factors that are unique to each individual consumer (Punj and Staelin, 1983).

3.1.1 The costs of information search

The cost of search has been defined as "the sum total of all direct and indirect costs associated with conducting an external search" (Punj and Staelin, 1983) (p. 368). To be more specific, costs of search include the perceived time and monetary expenditure of undertaking the search effort and the psychological costs/sacrifice (e.g., frustration) and physical effort of processing the information (Srinivasan and Ratchford, 1991; Schmidt and Spreng, 1996).

Numerous types of costs of information search have been suggested in previous studies. For example, Punj and Staelin's study of information search for new automobiles suggested costs can be associated with frustration caused by fighting traffic and dealing with ineffective car dealers. Opportunity cost of time and direct monetary search costs are the two cost components that are most frequently adopted (Srinivasan and Ratchford, 1991; Goldman and Johansson, 1978; Avery, 1996; Beatty and Smith, 1987). Another potential cost-related component is the effectiveness of search, which may be individual-specific, for consumers may differ in their ability to identify, access and exploit marketplace opportunities (Goldman and Johansson, 1978).

3.1.2 The benefits of information search

In the field of economics, the benefits of information search are defined as the realized and perceived benefits occurred in the search process (Srinivasan and Ratchford, 1991). In economic studies of information search, Stigler and other authors have used "price reduction" to measure these benefits (Stigler, 1961; Goldman and Johansson, 1978; Ratchford, 1982; Srinivasan and Ratchford, 1991; Telser, 1973). However, in subsequent studies, the concept has been expanded to include benefit components like satisfaction

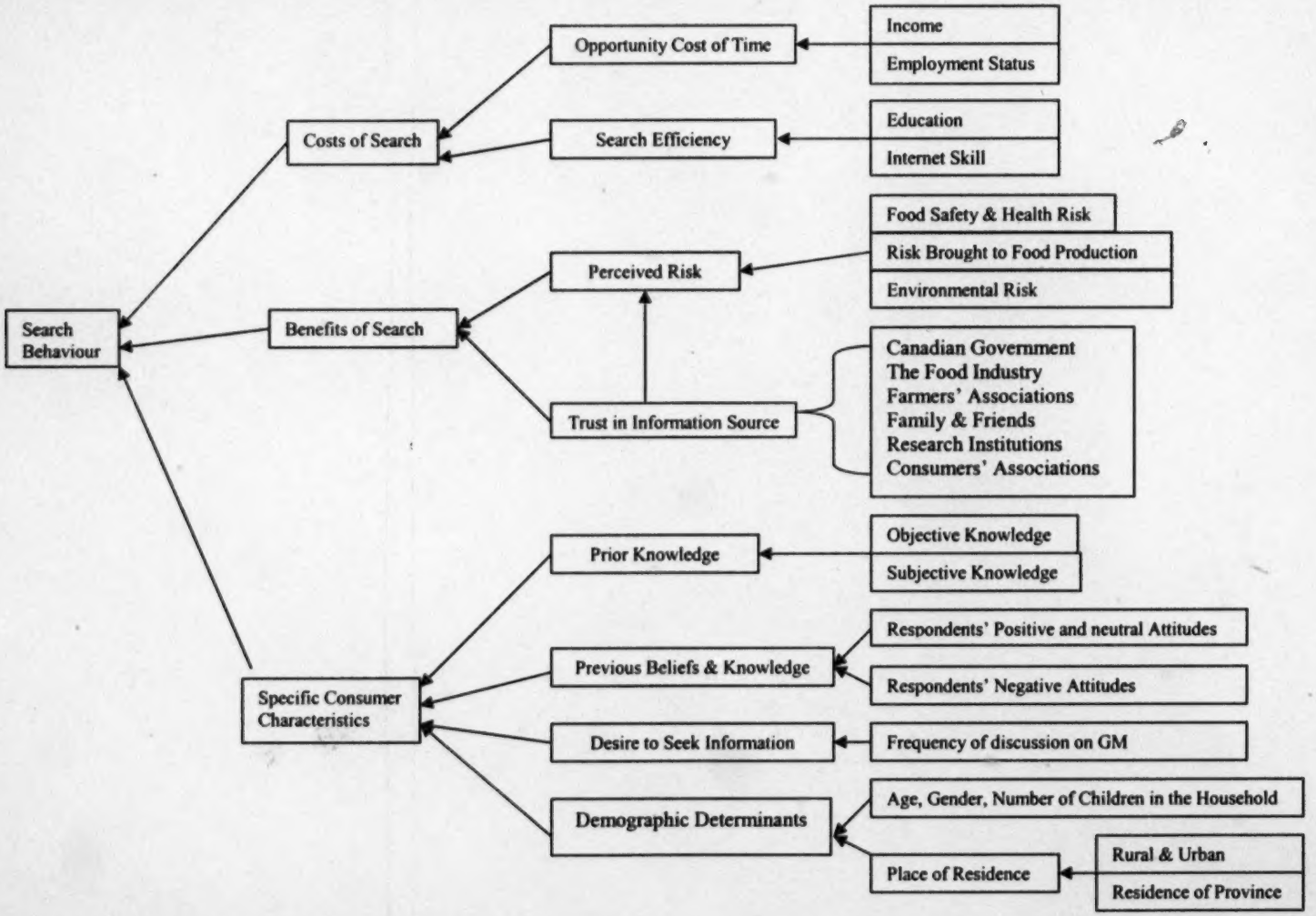
and enjoyment of search that are indicated from the disciplines of psychology and sociology (Punj and Staelin, 1983). In our analysis, one of the search benefits for GM information can be obtaining a better understanding of the concepts of GM technology and its application, including its effects on human health, as well as on the environment. Second, the benefits of search may reduce or clarify consumers' risk perceptions or concerns toward GM food, which could be associated with inaccurate with overstated or inappropriate information which might be provided by some media and special interests or activists. Two elements that we choose as proxies for the benefits of search on GM information are perceived risks that may be induced by GM food products and information on trust in information sources.

Perceived risk is the probability of any loss that can occur in the absence of external search, multiplied by the importance of that loss (Srinivasan and Ratchford, 1991; Murray, 1991). Marketing theorists conceive that consumers develop ways of reducing risks by searching for information that enable them to act with a degree of confidence in situations of uncertainty (Chen and He, 2003). From past research in the field of marketing, perceived risk has been classified into four categories by Schmidt and Spreng (Schmidt and Spreng, 1996). The first is "performance risk", which is a concern as to whether the product will perform as desired, which may be a particular issue for highly innovative products. A second aspect of risk is "social risk", which is a concern as to what others will think of the product. The third facet is "uncertainty risk", which is a concern about new technology relative to dominant product design or the durability and capability of the product. The last category is defined as "physical risk", which is a concern for the safety of the consumer and others (Schmidt and Spreng, 1996). Because

of possible uncertainties about the long-term effect of GM food on human health and the environment and ethical or social concerns about GM food, the component of perceived risk is of significance to our study.

Source credibility may not be directly related to consumer information search behaviour. However, this is an important determinant of people's reactions to information (Frewer et al., 1998). Trust in an information source has been identified as a key determinant in the effectiveness of any attempt to communicate risks (Slovic, 1993; Kasperson et al., 1992). Recognition of information sources may determine whether or not a consumer continues to search for more details of that information and which source s/he refers to. Overall, the effectiveness of risk communication depends to a large extent on the degree to which the information source is both dependent and trusted (Marks, 2001; Slovic, 1993). Consumers' lack of confidence in the ability of institutional information sources to manage the associated risks of agro-biotechnology can be expected to increase negative risk perceptions that consumers may already hold.

Figure 3-1: Theoretical Model of Information Search for GM foods: Hypothesised Determinants and Expected Directionality of Relationships



3.1.3 Specific consumer characteristics

3.1.3.1 *Prior Knowledge*

In the category of consumer-specific characteristics, four items will be discussed. The first is prior knowledge. A crucial element in the information-processing model of human behaviour is information stored in memory, i.e., prior knowledge. Empirical evidence indicates this affects information processing activities (Brucks, 1985). In other studies, researchers have used similar terms to define this construct. Srinivasan and Ratchford defined prior knowledge as "knowledge relating to a brand or product class that is stored in memory at the time that search commences" (Srinivasan and Ratchford, 1991)(p.235). Whereas previous studies have often treated prior knowledge as a single factor, Punj and Staelin adopted two different dimensions of knowledge in their study. The first dimension is "the quantity of directly relevant information and the consumers' ability to comprehend new information" (p.368), which was called "usable prior knowledge". The second dimension, called "prior memory structure", attempts to capture the idea that experience facilitates search by helping a person to organize new information more effectively (Punj and Staelin, 1983). Some studies try to make a distinction between objective knowledge (OK) and subjective knowledge (SK) (Brucks, 1985), both of which belong to the classification of prior knowledge. The conceptual difference between these two categories is that the former shows what consumers actually know, whereas subjective knowledge is defined as the consumer's conception of the amount he or she knows about the product. Objective knowledge can also be understood as "certainty of prior beliefs" (Urbany, 1986).

3.1.3.2 *Previous Product Experiences and Beliefs*

A second factor in the category of consumer-specific characteristics recognizes the variance in consumers' previous product experience and beliefs which may also guide consumer information search. Peoples' acquaintance with the product, especially their direct experience from use or consumption of the product, may directly lead to different responses to information. "Knowing and feeling are often effectively summarized as an *attitude*—an abstract concept conjectured to explain and predict behaviour" (Phillips and Corkindale, 2002)(p.115). Models of consumer decision-making usually portray behaviour as a function of attitudinal formation or change (Phillips and Corkindale, 2002). Attitudes, in some way, guide, influence, direct, shape, or predict actual behaviour (Kraus, 1995). Frewer and colleagues invoked the predictions of Social Judgement Theory [2] to explain that initial attitudes have been found to be an important determinant of post-intervention attitude (Frewer et al., 1998).

Empirical studies have indicated a strong relationship between consumers' previous experience and beliefs with search behaviour: greater prior purchase experience (which is assumed to lead to stronger prior beliefs) is associated with less search (Moore and Lehmann, 1980; Newman and Staelin, 1972). However, in a study by Goldman, it was hypothesized that the tendency to search for lower prices is positively related with knowledge of and experience in the market (Goldman and Johansson, 1978). Since the relationship between previous experience and belief could be either positive or negative,

[2] Social Judgement Theory is "an attributional approach featuring mechanisms of attitude formation and change that can occur in the absence of argument based processing. Attribution approaches emphasize how peoples' inferences about the cause of communicator attitudinal statements affect their agreement with these statements. The primary emphasis in social Judgement Theory is on the importance that prior attitudes have on reactions to incoming persuasive information" (Frewer, 2000)(p.17).

in this study, the sign of the coefficient for this construct is unknown and to be determined by the regression estimation results.

3.1.3.3 *Desire to Seek Information*

Consumers may vary in their desire to seek out or be exposed to a variety of alternatives, which is also called "the motivation to search" (Schmidt and Spreng, 1996; Bettman,1979). The desire to seek information indicates the importance of controlling for individual differences whenever conducting search activity experiments. Punj and Staelin postulated two factors that may affect the desire to seek information. One of these is a previous indication of a variety of seeking behaviour and the other is a previous indication of a willingness to acquire product information on a continual basis (Punj and Staelin, 1983). Schmidt and Spreng defined the desire to seek information as "the desire to expend effort in the collection and processing of information, which is characterized by both direction (which pieces of information are collected and processed) and the intensity of the effort (the level of goal-directed arousal)" (Schmidt and Spreng, 1996), p. 250). Moreover, Schmidt and Spreng suggested that the desire to seek information was influenced by several different individual-specific variables: "enduring involvement", "need of cognition" and "shopping enthusiasm" (Schmidt and Spreng, 1996). Furthermore, perceived costs and perceived benefits of search are hypothesized by Olshavsky and Wymer to influence consumers' desire to search. The strength of the desire for information about a good is assumed to be directly related to the importance of the good to the consumer (Olshavsky and Wymer, 1995).

3.1.3.4 *Demographic Factors*

Overall, results from previous studies on consumers' information search behaviour have pointed out the importance of socio-economic factors that might influence respondents' search activity. These socio-economic factors may include age, household income, gender, years of schooling, number of children in the household, occupation and even location of residence (Kiel and Layton, 1981; Schmidt and Spreng, 1996). A more detailed description of the demographic variables will be presented in the following section.

3.2 Overview of Empirical Model

3.2.1 The general approach

The findings of previous studies and the discussion presented in Section 3.1 influence our selection of relevant variables and their causal relationship with information search. The detailed definition of the problem and the general approach of the study is to some degree defined by the nature of the data, which are discussed in more detail in Chapter Four. This is drawn from an internet-presented choice experiment, in the course of which respondents had the opportunity to voluntarily access data through a hyperlinked computer click. This activity was followed by a series of questions that focused on respondents' attitudes to various food safety and environmental risks that might be associated with agriculture, including genetic modification; responses to attitudinal statements; queries about trust in information from various sources; as well as demographic and socio-economic questions. The empirical model of search includes three categories of factors associated with the costs of search, the benefits of search, and specific consumer characteristics.

3.2.2 Choice of variables for search costs

From the catalogue of costs of search, measures of the opportunity cost of time and search efficiency are chosen for this study. The socio-economic variables *Income* and *Employment Status* are taken as measures of the opportunity cost of time. Numerous studies have stated that search costs negatively affected search activity and information search varied inversely with search cost (Punj and Staelin, 1983; Srinivasan, 1986; Urbany, 1986). Schaninger and Sciglimpaglia found that wives working outside the home process less information than non-employed wives, which can be explained by search cost (to be specific, the opportunity cost of information search) being high for employed people (Schaninger and Sciglimpaglia, 1981). Therefore, in our study it is hypothesized that *Income* and *Employment Status* are negatively related to information search behaviour. The two variables of *Income* and *Employment Status* are introduced into the models separately as these are hypothesized as alternative measures and may be correlated. However, previous empirical analyses have not found a consistent relationship between income and search behaviour (Goldman and Johansson, 1978).

Since the data are collected from an online questionnaire survey, and the information search behaviour involves clicking on a hyperlink, the extent of respondents' Internet skills and educational level may aid the information search task. Thus variables "*years of schooling*" and respondents' "*Internet skill*" are applied as measures of search efficiency. Education and market experience are generally believed to contribute to a higher level of efficiency in search and thus, from this perspective, people with less education can be expected to engage in less search (Goldman and Johansson, 1978). In his study, Farley suggested that the effect of education is supposed to increase efficiency

and therefore, lead to more search activities (Farley, 1964). In our proposition for this variable, it is expected that search efficiency will have a positive relationship with search behaviour, since search efficiency may lead to the reduction of search costs and lead to more search activity. A higher education level is hypothesized to increase search efficiency, reduce search costs and thus lead to more information search activity. *Internet skill* is also believed to increase search efficiency. Therefore a positive relationship is hypothesized between *Internet skill* and search activity.

3.2.3 Choice of variables to proxy search benefits

Two features that are considered to represent the benefits of search adopted in this study are perceived risk and trust in information sources. Variables describing people's risk perceptions of biotechnology relating to human health and environmental issues are adopted as a proxy of consumers' perceived risk on GM food. Factor analysis is applied to the responses within several groupings of questions included in the original survey to reduce these to a smaller and more focused set of dimensions. Three variables identified from this represent respondents' views on *food safety & health risk*, *food production risk* and *environmental safety risks*[3]. *Food safety & health risk* measures personal risk perceptions through respondents' ratings on different issues relating to food safety and health, such as their ratings of concern to issues relative to food like "bacteria contamination of food", "pesticide residuals in food", "BSE", "fat and cholesterol content". *Food production risk* relates to respondents' personal risk perceptions of cited food production safety issues, including use of hormones, antibiotics, food additives and genetic modification. *Environmental risks* refers to respondents' personal risk perceptions

[3] Appendix 1 gives more detailed definitions of these variables.

based on their ratings of possible environmental safety issues that might be associated with modern agriculture, including "Water pollution by chemical run-offs from agriculture", "Soil erosion through agricultural activity", "Genetic modification/ engineering, Resistance to herbicides and pesticides", "Adverse effects of agriculture on biodiversity" and "Agricultural waste disposal (e.g., animal manure)".

High levels of perceived risk have been suggested to increase information search because one way of reducing risk is to obtain more information and so reduce uncertainty (Schmidt and Spreng, 1996). Thus it is hypothesized that measures of perceived risk will have a positive relationship with information search behaviour. This is based on the hypothesis that when people perceive more risk, they will respond with more information search activities, which will ease uncertainty and as a result, increase the benefits of search.

The survey which provides the data for this study includes data on respondents' assessments of their trust in information from six organizations including "the Canadian Government", "the food industry", "farmers' associations", "family/friends", "research institutions" and "consumer associations". Previous studies on the credibility of information sources on GM product suggest that the food industry may be the least trusted information source because of its financial interests in GM food (Hunt and Frewer, 2001). A large-scale survey research project in the European Union indicates higher public confidence in doctors, university scientists and nongovernmental organizations (e.g., consumer and environmental organization) than in governmental actors (Lang et al., 2003). Family and friends are usually ranked high on the accuracy of product information as an information source. We trust our friends in a way we do not trust

people or institutions we do not know well (Mitra et al., 1999). The survey data employed in this study suggest that consumers' associations and research institutions are the most generally trusted information sources (Veeman et al., 2004). The Canadian Government is routinely identified as having low credibility ratings (Rothenberg, 1994). Bauer and his colleagues concluded, based on a survey implemented in the U. K., that the most credible sources of GM food risk information in that context were associated with environmental and farmers' groups while national public bodies and industry were associated with very low levels of confidence (Bauer et al., 1998). From the survey which provides the data for this study, it is seen that Canadian government and the food industry do not tend to be viewed as trustworthy sources of GM/GE food information. Family/friends, consumers' associations, and research institutions are indicated to be relatively trustworthy information sources on GM/ GE products. We adopt the variable of "trustworthiness of information sources" as a proxy for the benefit of search and hypothesize that those respondents who expressed a low level of trust in information offered by Canadian government and the food industry may tend to seek more information. This implies the hypothesis that respondents who assessed the other four cited information sources to be trustworthy information sources tend to search less for information about the food product.

3.2.4 Choice of variables proxying specific consumer characteristics

The last, but not least, category of variables includes specific consumer characteristics. The following four variables are selected for this category: consumers' assessment of their prior knowledge of the subject, previous product experience and beliefs, consumers' desire to seek information and their socio-demographic factors.

3.2.4.1 *Prior knowledge of the subject*

Representing consumers' prior knowledge of the subject, the variable *Objective knowledge* is specified as an objective measure of each respondent's knowledge derived from the percentage of correct answers to six questions that had been asked related to GM technology and its applications. A further variable used as a proxy of respondents' subjective knowledge is derived from a question that asks respondents to rate the extent of their information on GM technology.

For the relationship between consumers' prior knowledge and their information search behaviour, there are two opposite points of view. Some analysts postulate that the more the information obtained prior to active search, the less the need for external search (Urbany, 1986), which is explained by the "interchangability" of internally retrievable information and externally available information in terms of helping consumers make a purchase decision. However, a different belief is that more detailed information in the memory structure helps a person comprehend newly obtained information. In this way, prior knowledge provides a stimulus for external search (Punj and Staelin, 1983).

The relationship between objective knowledge and search behaviour would be hypothesised to be negative following Urbany (Urbany, 1986), assuming that if people answer such questions correctly, they would search less for decision-related information, since they are more certain about their prior beliefs on the product or issues. However, according to Schmidt and Spreng (1996), higher levels of objective knowledge should increase a person's ability to engage in external search for information. From the previous literature, it appears that the relationship between subjective knowledge and information search behaviour might be positive or negative or there may be no

relationship. Therefore, no explicit hypotheses are made on the nature of a relationship between the variables of SK (subjective knowledge) and OK (objective knowledge) and information search and the signs of the coefficients for these variables remain to be decided in our study.

3.2.4.2 *Previous experience and beliefs*

Two variables are constructed to represent respondents' "previous (product) experience and beliefs." Respondents to the survey were queried on their opinions on issues related to GM/ GE applications in food production. By factor analysis, two factors are specified from this set of questions, one of which identifies the respondent's *positive or neutral attitude* toward GM food, while the other represents respondent's *negative attitudes*. Rogers cited previous economic research that indicates stronger prior beliefs (on stores) would lead to less search (for lower prices) with some researchers emphasizing that the correctness of prior information may lead to less search (Rogers,1983). However, Rogers also noted that evidence drawn from the field of psychology suggests a positive relationship between beliefs and search behaviour such that if a consumer has a positive attitude toward GM technology, he/she searches more information (Rogers,1983). This phenomenon can be explained by the feature that individuals generally tend to expose themselves to ideas that are in accordance with their interests, needs or existing attitudes. People may consciously or unconsciously avoid information that is contradictory to their predispositions (Rogers,1983; Frewer, 2000). Therefore, no explicit hypotheses are made on the nature of a relationship between "previous experience and beliefs" and information search in our study and the sign of the coefficient for the variable beliefs remains to be decided.

3.2.4.3 *Desire to seek information*

In research by Punj (1983), magazine readership is used to measure the desire to seek information. Similarly, we use "*frequency of discussion on GM topics*" to measure respondents' desire to seek GM information. The usual hypothesized relationship between this variable and search behaviour is positive (Goldman and Johansson, 1978; Punj and Staelin, 1983).

3.2.4.4 *Socio-demographic variables*

The last construct relative to specific consumer characteristics concerns socio-economic variables. *Age*, *gender*, *household income*, *years of schooling*, and *number of children in the household* are chosen here as commonly used search determinant variables in studies of individual's responses (Kiel and Layton, 1981; Chen and He, 2003; Schaninger and Sciglimpaglia, 1981; Beatty and Smith, 1987; Cole and Balasubramanian, 1993; Gregan-Paxton and John, 1995; Newman and Staelin, 1972). In our study, we additionally introduce *Place of Residence* to the analysis, relating to *whether people are from a rural or urban area* (Urbany, 1986). Another related variable is *regional residence by province of Canada* (Connell and Crawford, 1988). The effect of both factors on search activities is assessed separately.

The hypothesized relationship between age and search is negative. In a study by Cole et al. of the effect of age on the use of nutritional information, it was indicated that when shoppers were instructed to select a cereal according to specific nutritional criteria, elderly subjects were less likely than younger subjects to search intensely and to select an appropriate cereal (Cole and Balasubramanian, 1993; Schaninger and Sciglimpaglia, 1981). Schaninger explained this phenomenon as either that older consumers were less

capable of processing large amounts of information or that older consumers were more capable of distinguishing between relevant and irrelevant information, due to greater market experience (Schaninger and Sciglimpaglia, 1981). As for gender, females are typically more inclined to search information than males (Avery, 1996) and women in general are more concerned with food safety (Li et al., 2002). In previous research, it was found that consumers who initiated search in smaller, outlying geographic areas shopped two or more stores just as frequently as those in downtown areas with smaller distances between stores in an information search targeted to the lowest price offered in the market (Bucklin, 1966). Nonetheless, consideration of geographic location may be appropriate in our study, since there might be differences in availability of product information and how the information is offered in different regions within Canada.

4 THE DATA

4.1 Introduction to the Survey

The survey questions for this study were developed by a research team of Dr. Anna Huennemeyer, Dr. Michele Veeman, and Dr. Victor Adamowicz in the Department of Rural Economy at the University of Alberta. The questionnaire was implemented in the fall of 2002 and the data for this thesis study were drawn from 445 surveyed respondents across Canada (both in English and French). The computer-based, internet-administered survey instrument was facilitated by an international market research company and drawn from their Internet panel of 40,000 representative Canadian households. In this experiment, 445 consumers were asked to complete a set of eight stated choice questions for pre-packaged, sliced bread that could include GM ingredients and for which optional information was provided and could be accessed by clicking on a hyperlink (Veeman et al., 2004). Pre-packaged, sliced bread is chosen to be the food object of the experiment for four reasons: 1) since bread is consumed in almost all Canadian households, there is expected to be little bias that might be introduced from lack of familiarity of the product; 2) since bread is a staple food, consumers are expected to view choices for this product more seriously and thoughtfully than for snack food; 3) although genetically modified wheat had been proposed for commercial production, this product had not been approved; and 4) wheat is a major Canadian agricultural product and the issue of consumers' response to genetically modified wheat is of current policy interest (Hu et al., 2004).

The survey contained 26 questions and was expected to take about 20 minutes to complete. In the first part of the survey, respondents were asked to choose their preferred typical bread with respect to the identified major attributes and their levels. These

attributes include: brand name with levels *national* brand and *store* brand, type of flour with levels of white, partly wheat, whole wheat and multi-grain, and a price that reflects what respondents most often paid for their typical bread purchase. Secondly, respondents chose between their previously specified favourite bread and different bread products with an environmental and/or health benefit, and/or a GM attribute, at different price levels. The benefits could be specified to result from genetic modification.

A special feature of this study is that it made additional product information voluntarily available to consumers, through an experimental information component to the study. Respondents could access information on different topics according to their random assignment to different information scenarios. The information could vary in content about the GM technology (positive and/or negative, or none) as well as information source (generic or specific). It was possible to access information on possible health and environmental attributes of the bread product in the experiment. This approach was intended to simulate aspects of information search in consumers' shopping experience as consumers may in practice check a label for more detailed information or, in the survey, could click a hyperlink to access particular types of information.

In the survey, concurrent with their choice of different products, respondents could voluntarily search for information by clicking hyperlinks to six different topics relating to the health attribute, environmental attribute or GM attribute of the bread product. The six information topics presented in the questionnaire were:

Topic 1: "To find out more about the vitamins in this bread, please click here."

Topic 2: "To learn why vitamins are important, please click here."

Topic 3: "To find out why this product is environmentally friendly, please click here."

Topic 4: "Why is reducing herbicides in agriculture important? Please click here."

Topic 5: "To find out whether genetically modified/ engineered foods are safe to eat, please click here."

Topic 6: "To find about environmental effects of genetically modified crops, please click here."

Topic 1 and Topic 2 focused on a possible health attribute of the product, Topic 3 and Topic 4 related to its possible environmental attribute, with the last two topics providing information on the possible GM attribute of the product. Only after a respondent clicked the corresponding hyperlinks, did s/he see the detailed information on the attributes. Regarding descriptive statistics, 31% of the sample population accessed the health attribute information of the product (clicking the hyperlinks in Topics 1 and 2), 36% of the respondents searched for the environmental attribute information (clicking the hyperlinks in Topics 3 and 4) and 24.7% of them accessed the GM attribute information (clicking the hyperlinks in Topics 5 and 6). The "clicks" data are the focus of the analysis of this study.

A subsequent part of the survey queried respondents on perceptions and attitudes to GM food. Respondents were asked to rate various risks associated with food and agriculture and to give opinions on a variety of statements relating to preferences and attitudes concerning risks and GM food. In the current study, questions are selected from this section of the underlying data set as measures of peoples' perceptions of the risks of genetic modification and their trust in different sources of information on this topic.

Socio-economic and demographic data were also recorded. Information on gender, age, the number of family members, years of schooling, employment status,

household income and place of residence were collected from the respondents. In the sample that applies to the current study, there were 181 males and 263 females. The average age of the respondents was 45 years. The percentage of respondents with no children is 59% of the whole sample population. The average household income of respondents was between $70,000 and $79,999. On average, respondents had finished some university or college education. In total 272 of the respondents were full or part-time employees and 157 were retired, full or part-time students or homemakers. In the sample, 51 people were from Province of British Columbia, 55 were from the Prairie Provinces (Alberta, Saskatchewan and Manitoba), 192 were from Ontario, 113 were from Quebec and 33 were from the Maritime Provinces (New Brunswick, Nova Scotia, Newfoundland and Prince Edward Island). Of all of these respondents, 158 were from rural areas with 258 respondents from urban areas[4].

Overall, the sample from this study reflects several general characteristics of households in Canada. The geographic distribution of the sample across Canada follows the distribution of Canada's population. However, the sample is somewhat over-represented by respondents with higher income levels and higher educational background. It is also noted that Ontario and Quebec were slightly over-represented in the sample relative to the population distribution and that the remainder of Canada was slightly under-represented (Hu et al., 2004).

[4] In previous statistical studies, different definitions have been adopted to define urban/ rural areas. The definition is usually defined based on population numbers, and the definition of an urban area can range from 1,000 to 100,000 people (Statistics Canada, 2001; Plessis et al., 2002). An urban area as defined in our study is an area with population more than 30,000 people. Thus rural areas refer to places of residence with populations less than 30,000.

4.2 Descriptive Analysis of the Survey Data

Based on the general introduction above, we provide a descriptive analysis of respondents' information seeking behaviour in the following five sections. The first shows the relationship between the active search for consumer information by individuals (i.e. according to whether they sought information) and their responses to questions that assess perceptions of the potential health and environmental benefits and risks of GM/GE in food products. The second examines a cross-classification between respondents' knowledge about GM/GE food products and the respondents' information-seeking behaviour. In the survey, respondents' knowledge was tested with a series of "true" and "false" statements on GM technology, as well as through a question that directly asked, "How well informed would you say you are about genetically modified/engineered foods?" In the third section, respondents' information search behaviour is related to their opinions on issues about application of genetic modification in food production. The fourth cross tabulation examines a possible relationship between respondents' information search behaviour and their assessment of the trustworthiness of different sources of information. The remaining cross tabulations demonstrate consumer information search behaviour relative to respondents' socio-demographic information for those who accessed the attribute information of the product in the survey. This was the case for 47 % of the entire sample population of 445.

4.2.1 Attitudes toward health and environmental risks

4.2.1.1 *Attitudes toward health and food safety risks:*

In the course of the survey which is the source of data for this study, respondents had been asked to state the level of risk (high, moderate, slight, almost none, or don't

know/not sure) they perceived for eight different health and safety issues associated with food: bacteria contamination, pesticide residuals, use of hormones, use of antibiotics, BSE (mad cow disease), use of food additives, use of GM/GE, as well as fat and cholesterol content of food. The responses were coded "1" for "high risk" to "4" for "almost no risk". The "DK/NS" (don't know/ not sure) responses were coded "5", and were not included in these tabulations or in estimating the final regression models of this study. To simplify the analysis, the responses of "high risk" and "moderate risk" were aggregated and viewed as the perception of being risky. In contrast, the responses "slight risk" and "almost no risk" were also aggregated to indicate a perception of low risk toward the related issues. Table 4-1 shows the number and the percentage distribution of all respondents regarding their perceptions on food safety and health issues.

Table 4-1: The number and percentage of all respondents who perceived the food safety and health issues to be risky/not risky

	Risky		Not Risky	
	Number	Percentage	Number	Percentage
Bacteria contamination	298	67%	131	29%
Pesticide residuals	316	71%	117	26%
Use of hormones	295	66%	119	27%
Use of antibiotics	287	64%	126	28%
Mad cow disease	196	44%	236	53%
Food additives	226	51%	205	46%
Use of GM/GE	203	46%	210	47%
Fat and cholesterol	292	66%	149	33%

Figure 4-1[5] below illustrates the results of cross tabulating the information that an individual considered the specified health and safety issues to be risky and their

[5] A Chi-squared test has been used to test on the significant difference of the proportions listed in Figure 4-1 to Figure 4-6, Figure 4-8 and Figure 4-17. Regarding the requirement for a Chi-squared test, it is assumed that the population of respondents sought information on the health, environmental and GM attributes of the product independently and exclusively. However, this may not always be the case since respondents were allowed to access information on one, two or all of the attributes. Therefore the results of these tests should be interpreted with caution.

behaviour on seeking information (i.e. referring to those who clicked the hyperlinks for this). The information search activity of the respondents who did not perceive much risk in the possible food safety issues is not depicted in Figure 4-1[6]. From the graphical presentation, it seems that respondents are generally more likely to search for product related information if they consider "Food Additives" to be risky. Respondents who rated the food safety issues to be risky tended to seek more information on the environmental attribute of the product.

Figure 4-1: Information Search Behaviour of Respondents Who Perceived the Health and Food Safety Issues to be Risky

* represents the significant proportions, see Appendix 3.1 for details.

Figure 4-1 shows that respondents with high levels of risk perceptions about the listed food safety issues were generally more likely to search for information on the environmental attribute of the product than to search for information on the health and GM attributes of the product. Relative to respondents' concerns on each of the eight cited food and health safety issues, respondents show different interests in the three attributes of the product with the environmental attribute information being the most frequently accessed, followed by information on the health and GM attributes, if the topics were considered as risky. It is also noted that respondents who perceive "food

[6] Please consult Appendix 4 for the actual number and percentages of respondents accessing information if they perceived the health and food safety issues to be risky.

additives" to be risky tended to access more information on each topic somewhat more frequently than was the case for other respondents.

4.2.1.2 *Attitudes toward environmental safety risks:*

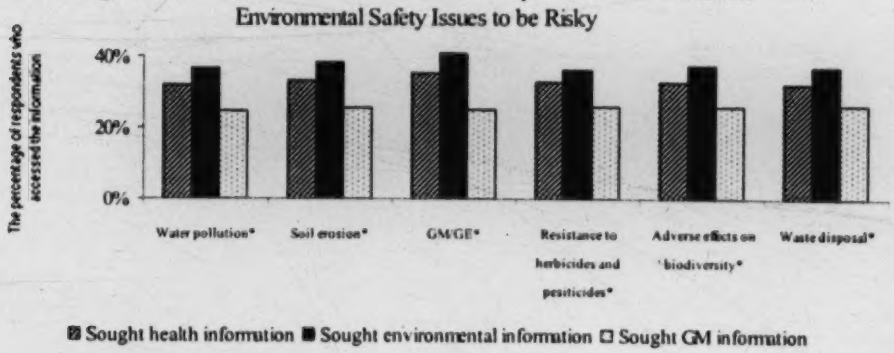
In the survey, respondents were also asked to rank the risk levels for each of six issues in the context of environmental safety issues that may be associated with modern agriculture. The stated issues were: "water pollution by chemical run-offs from agriculture"; "soil erosion through agricultural activity"; "genetic modification/ engineering"; "resistance to herbicides and pesticides"; "adverse effects of agriculture on biodiversity"; and "agricultural waste disposal (e.g., animal manure)". Again the responses were coded "1" for "high risk" to "4" for "almost no risk". The "DK/NS" (don't know/ not sure) responses were coded "5", and were not included in the tabulations given here and in estimating the final regression models of this study. Again, to simplify the analysis, the responses of "high risk" and "moderate risk" are aggregated as the perception of being risky. In contrast, the responses "slight risk" and "almost no risk" are also aggregated and taken to indicate a lack of perception of risk toward the related issues. In Table 4-2, the actual number and percentage distribution of respondents regarding their perceptions about the environmental issues are listed.

Table 4-2: The number and percentage of all respondents who perceived the environmental safety issues to be risky/not risky

Environmental safety issues	Risky		Not Risky	
	Number	Percentage	Number	Percentage
Water pollution	403	91%	38	9%
Soil erosion	295	66%	128	29%
GM/GE	256	58%	158	36%
Resistance to herbicides and pesticides	371	83%	59	13%
Adverse effects on biodiversity	289	65%	109	24%
Waste disposal	341	77%	95	21%

The results of cross tabulating the responses of those who considered the specified environmental safety issues to be risky and who sought information are shown in Figure 4-2[7]:

Figure 4-2: Information Search Behaviour of Respondents Who Perceived Environmental Safety Issues to be Risky



* represents the significant proportions, see Appendix 3.1 for details.

Regarded as a whole, less than 50% of those who considered the environmental safety issues to be risky "clicked" the corresponding hyperlinks to gain the information about the attributes of the product. Again it appears that respondents who perceived environmental safety issues to be risky were more likely to access the information on environmental benefits in the experimental component of the survey. Those respondents who assessed "the application of GM/GE technology in agriculture" to have an adverse effect on environmental safety tended to access the environmental attribute information of the product more frequently. In each cross tabulation, it is seen that information on the environmental attribute of the product was sought somewhat more frequently than for the other types of information. Information about the health and GM attributes of the product were not accessed as frequently as was the environmental attribute information. Respondents may vary in their perceptions of risk on different features of the cited

[7] Please consult Appendix 5 for the actual number and percentages of respondents accessing information if they perceived the environmental safety issues to be risky.

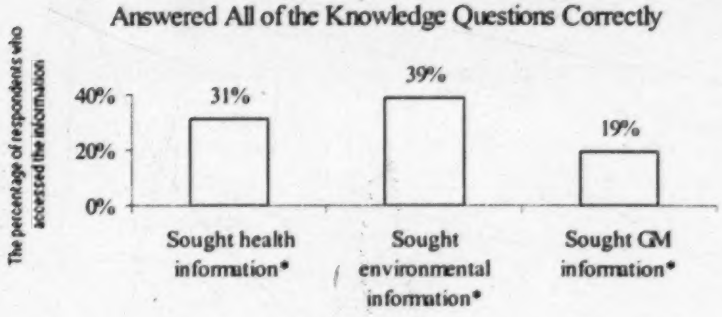
environmental issues, but did not show much discrepancy in their information search about the different attributes of the product according to Figure 4-2. In that figure the three columns in each set representing respondents' information search on the health, environmental and GM attributes of the product respectively are almost identical across the different issues.

4.2.2 Knowledge about GM/GE food products

4.2.2.1 *Objective knowledge of GM/GE*

Respondents had been asked whether they believed each of a series of statements about GM/GE technology to be 'true', 'false', or 'not sure'. There were four false statements: "GM/GE applies only to plants not animals"; "eating GM/GE can cause people's genes to be modified"; "all food in Canadian supermarkets has GM/GE ingredients"; and "in Canada labelling is required for foods with GM/GE products". There were two true statements: "canola, corn, soybean, and potato are GM/GE crops produced in Canada"; and "GM/GE food is available in Canadian supermarkets". The responses for each of these statements were coded as "1" for "true" and "2" for "false". All "don't know/not sure" responses were coded as 3. The graph below (Figure 4-3) illustrates the information search behaviour of those respondents who correctly answered these questions.

Figure 4-3: Information Search Behaviour of Respondents Who Answered All of the Knowledge Questions Correctly



* represents the significant proportions, see Appendix 3.1 for details.

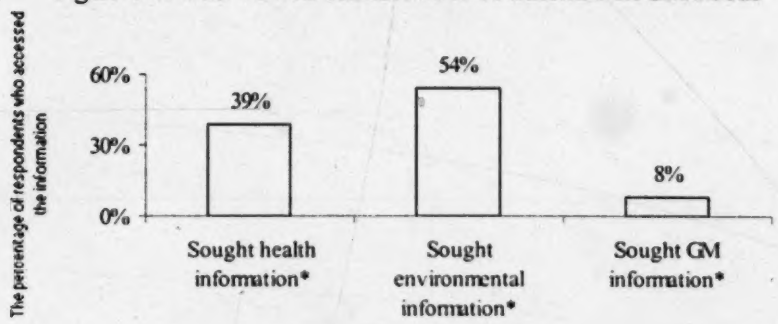
As introduced in the empirical model, variables that measure "objective knowledge" of how much a respondent actually knows about GM are postulated to influence information search. From the survey data, about 33% of 445 respondents answered all of the six questions correctly. As shown in Figure 4-3, among those 147 respondents who answered all six questions correctly, 57 respondents (39% of 147 respondents) accessed information on the environmental attribute of the product, 46 respondents (31% of 147 respondents) sought information on the health attribute of the product and only 28 respondents (19% of 147 respondents) accessed information on the GM attribute of the product.

4.2.2.2 *How well informed respondents viewed themselves to be*

Respondents had also been asked directly "how well informed would you say you are about genetically modified/engineered foods?" This is used as a measure of the subjective knowledge of GM food held by respondents. Five options were offered to respondents: "very well informed", "somewhat informed", "not very informed", "not at all informed", and "don't know/not sure", which were coded from "1" to "5" respectively. To simplify the analysis, the responses of "very well informed" and "somewhat

informed" are aggregated as the perception of being "informed". In contrast, the responses "not very informed" and "not at all informed" are also aggregated to indicate a lack of subjective knowledge. In our sample, 224 respondents thought they were informed about genetically modified/engineered food, and 221 thought they did not know much about GM/GE. Figure 4-4 shows the cross tabulation of information access behaviour for those who viewed themselves to be informed about GM food.

Figure 4-4: Who Viewed Themselves to be Informed on GM Foods



* represents the significant proportions, see Appendix 3.1 for details.

From Figure 4-4, it is seen that 121 respondents (54% out of 224) who thought they were "informed" on GM food accessed the environmental attribute information of the product, 87 respondents (39% of 224) sought information on the health attribute of the product, while only 18 respondents (less than 10% of those respondents) accessed information on the GM attribute of the product. Respondents were more likely to access to the environmental attribute information if they thought themselves to be informed about GM foods.

4.2.3 Attitudes toward the application of GM/GE in food production

The respondents had been asked to provide their opinions in the form of ranked responses to 13 statements that related to the application of GM/GE in food production. Some of these were couched in the form of positive statements about genetic modification/engineering in food production, while other statements were expressed in negative terms. The respondents selected one of five responses to each of the 13 attitudinal statements: "strongly agree", "somewhat agree", "somewhat disagree", "strongly disagree" and "don't know/not sure", which were coded as "1" to "5" respectively. "Strongly agree" and "somewhat agree" were aggregated and considered as "agree", while "somewhat disagree", "strongly disagree" were aggregated and considered as "disagree". The following table (Table 4-3) illustrates the number and percentage of all respondents' attitudes (agree/disagree) toward the application of GM/GE in food production.

Table 4-3: The number and percentage of all respondents who agree/disagree on statements of the application of GM in food production

The topics relating to the application of GM/GE in food production:	Agree		Disagree	
	Number	Percentage	Number	Percentage
"The human health benefits of GM/GE crops outweigh the human health risks."	144	32%	212	48%
"I would sample foods from GM/GE crops to find out whether I like them."	249	56%	160	36%
"Foods derived from GM/GE crops are less risky for humans than foods from GM/GE animals."	98	22%	209	47%
"I would prefer cheaper foods from GM/GE crops over more expensive GM-free products."	143	32%	267	60%
"Canada should advance the general field of GM/GE technologies to prevent or cure diseases."	294	66%	101	23%
"The overall benefits for the environment of GM/GE crops outweigh the overall environmental risks."	144	32%	214	48%
"Feeding animals with GM/GE feed is not a concern."	143	32%	255	57%
"All things considered, benefits of GM/GE in food production outweigh risks."	162	36%	214	48%
"Foods derived from GM/GE animals are simply not necessary in Canada."	207	47%	168	38%

"Increased GM/GE crops in Canada will lead to a harmful concentration of corporate power."	189	42%	153	34%
"GM/GE in agriculture is unnatural."	242	54%	159	36%
"GM/GE applied to livestock will worsen animal welfare."	169	38%	153	34%
"Overall, I am more skeptical of GM/GE applications in livestock than in crops."	239	54%	146	33%

4.2.3.1 *Positive and neutral attitudes toward application of GM/GE in food production*

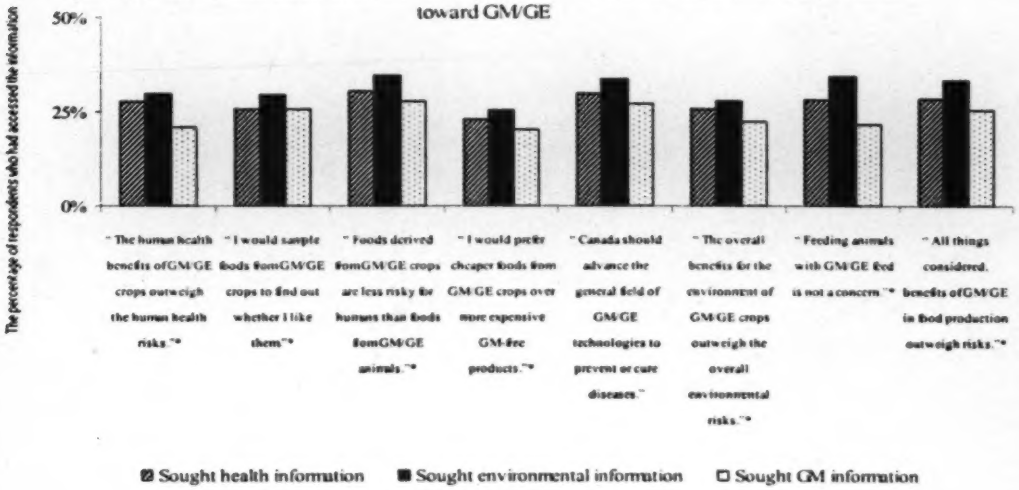
Questions that suggest positive and neutral attitudes were couched as the following statements: "human health benefits of GM/GE crops outweigh the human health risks"; "I would sample foods from GM/GE crops to find out whether I like them"; "foods derived from GM/GE crops are less risky for humans than foods derived from GM/GE animals"; "I would prefer cheaper foods derived from GM/GE crops over more expensive GM-free products"; "Canada should advance the general field of GM/GE technologies to prevent or cure diseases"; "the overall benefits for the environment of GM/GE crops outweigh the overall environmental risks"; "feeding animals with GM/GE feed is not a concern"; "all things considered, benefits of GM/ GE in food production outweigh risks".

Figure 4-5[8] and Figure 4-6[9] show the results of cross-tabulation of respondents who accessed information and their responses to the various attitudinal statements (positive, neutral and negative). Responses of "strongly agree" and " agree" to the first group of statements generally suggests a positive attitude to GM. Cross tabulations for those whose aggregated responses were in this category for the first set of attitudinal statements relative to their information access behaviour are shown in Figure 4-5. This shows that less than 40% of people in this category chose to access information on any

[8] Please consult Appendix 6 for the actual number and percentages of respondents accessing information if they held positive and neutral attitudes toward GM/GE.
[9] Please consult Appendix 7 for the actual number and percentages of respondents accessing information if they held negative attitudes toward GM/GE.

attribute information of the product. In general, respondents tended to access more information about the environmental attribute of the product, compared to their search activity on the other two attributes of the product— the health and GM attributes.

Figure 4-5: Information Search Behaviour of Respondents Who Hold Positive and Neutral Attitudes toward GM/GE

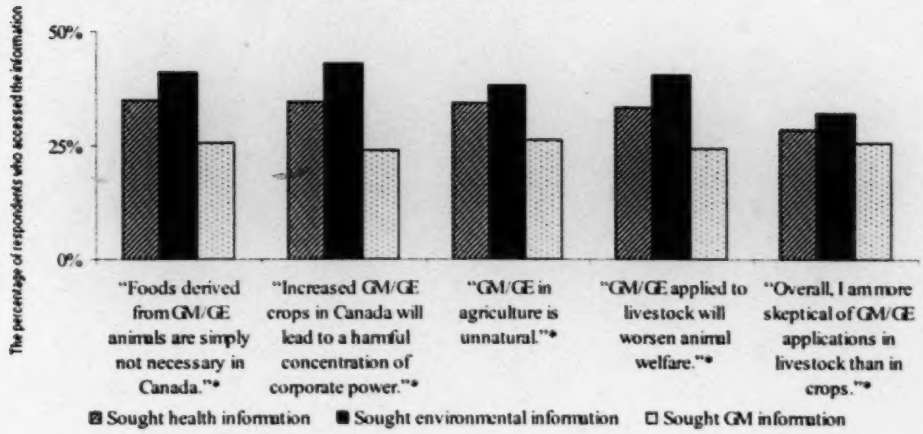

The percentage of respondents who had accessed the information
50%
25%
0%
" The human health benefits of GM/GE crops outweigh the human health risks."*
" I would sample foods from GM/GE crops to find out whether I like them"*
" Foods derived from GM/GE crops are less risky for humans than foods from GM/GE animals."*
" I would prefer cheaper foods from GM/GE crops over more expensive GM-free products."*
" Canada should advance the general field of GM/GE technologies to prevent or cure diseases."
" The overall benefits for the environment of GM/GE crops outweigh the overall environmental risks."*
" Feeding animals with GM/GE feed is not a concern."*
" All things considered, benefits of GM/GE in food production outweigh risks."*
Sought health information
Sought environmental information
Sought GM information

* represents the significant proportions, see Appendix 3.1 for details.

4.2.3.2 *Negative attitudes toward applications of GM/ GE in food production*

The statements that are couched in negative language and suggest a negative attitude are listed below: "foods derived from GM/GE animals are simply not necessary in Canada"; "increased GM/GE crops in Canada will lead to a harmful concentration of corporate power"; "GM/GE in agriculture is unnatural; "GM/GE applied to livestock will worsen animal welfare"; and "Overall, I am more sceptical of GM/GE applications in livestock than in crops".

Figure 4-6 : Information Search Behaviour of Respondents Who Hold Negative Attitudes toward GM/GE


The percentage of respondents who accessed the information
50%
25%
0%
"Foods derived from GM/GE animals are simply not necessary in Canada."*
"Increased GM/GE crops in Canada will lead to a harmful concentration of corporate power."*
"GM/GE in agriculture is unnatural."*
"GM/GE applied to livestock will worsen animal welfare."*
"Overall, I am more skeptical of GM/GE applications in livestock than in crops."*
Sought health information
Sought environmental information
Sought GM information

* represents the significant proportions, see Appendix 3.1 for details.

Comparison of Figure 4-6 with Figure 4-5 suggests that respondents who agree with the negative statements about the application of GM techniques in agriculture are more likely to access information on the product than the respondents who held more positive attitudes toward GM techniques. Even so, irrespective of their apparent attitudes on GM technology and food, more respondents accessed information on the environmental attribute, followed by the health attribute of the product. Information on the GM attribute of the product was the least accessed.

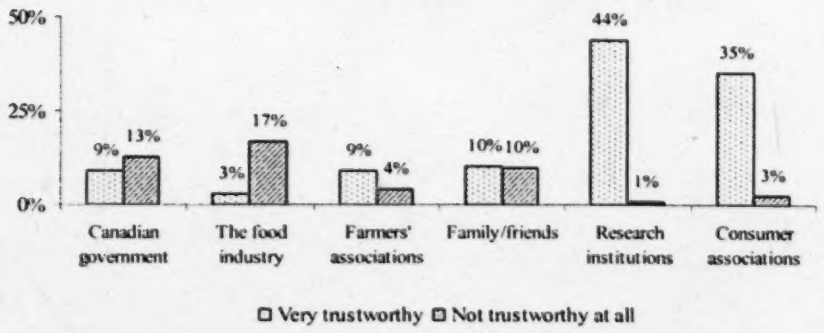
4.2.4 Perceptions of trustworthy information sources on GM/GE food products

The respondents were asked to indicate the level of trust they had in various sources for information about GM/GE food products. The cited sources of information were "Canadian Government", "the food industry", "farmers' associations", "family/friends", "research institutions (e.g. universities)", and "consumer associations". Five different responses that could be chosen were: "very trustworthy", "somewhat trustworthy", "not very trustworthy", "not at all trustworthy" or "don't know/not sure",

which were coded as "1" for "very trustworthy" to "4" for "not at all trustworthy" with "5" as "DK/NS".

Figure 4-7 depicts the levels of trustworthiness respondents assessed for each of the six cited information sources. The food industry has the lowest credibility (9% of the whole sample population) among all information sources (only 40 respondents out of 445 believed the food industry to be a trustworthy information source), with the Canadian Government ranking as the second least reliable information source. On the other hand, almost half –196 respondents (44% of the whole sample population) evaluate "research institutions" as a very trustworthy information source and about 35% of respondents (156 out of 445 respondents) viewed consumer associations as a very reliable information source. Generally speaking, these features are consistent with conclusions drawn from other studies.

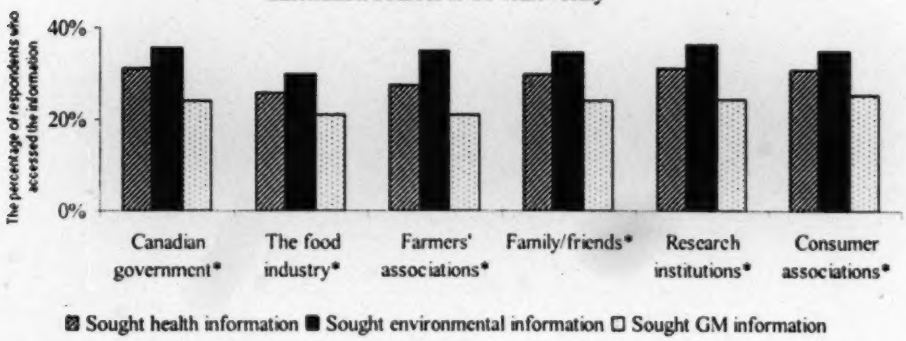
Figure 4-7: Information Sources and Their Trustworthiness



An issue we consider here is whether a respondent's perception of the credibility of information sources may have an effect on his or her information search behaviour. To assess this, the options of "very trustworthy" and "somewhat trustworthy" are aggregated

and represented by "trustworthy". Figure 4-8[10] depicts the information search behaviour of those who valued each of the various cited sources as "trustworthy".

Figure 4-8: Information Search Behaviour of Respondents Who Evaluated the Information Sources to be Trustworthy



* represents the significant proportions, see Appendix 3.1 for details.

From Figure 4-8, it does not seem that there is much differentiation in respondents' information search relative to their views on the trustworthiness of the different information sources. There is a slight tendency for those respondents who viewed the food industry as a trustworthy information source to search less for information on each of the three attributes of the product than those who evaluated the other information sources as trustworthy. The pattern of more frequent access to seek information on the environmental, then the health, and then the GM attributes continues.

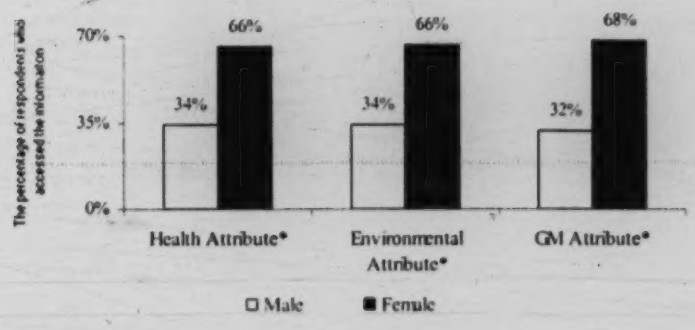
4.2.5 Demographic variables

4.2.5.1 *Gender*

[10] Please consult Appendix 8 for the actual number and percentages of respondents accessing information if they evaluated the information sources to be trustworthy.

Figure 4-9 [11] shows the effect of gender on consumer information search behaviour on any of the attribute information of the product. Among the 138 respondents who accessed the health information, 47 respondents were male (34% of 138) and 91 were female. There were 54 males (34%) among the 160 respondents who accessed the environmental information, and 106 were female (66% of the 160 respondents). For the 110 respondents who searched for the GM information, 35 were male (32% of the 110 respondents) and 75 were female (68% of the 110 respondents).

Figure 4-9: The Effect of Gender on Information Search Behaviour



* represents the significant proportions, see Appendix 3.2 for details.

Gender seems to be an important factor influencing respondents' behaviour in seeking information. It is shown in Figure 4-9 that female respondents were more likely than males to seek information relating to all three attributes of the product.

4.2.5.2 *Age*

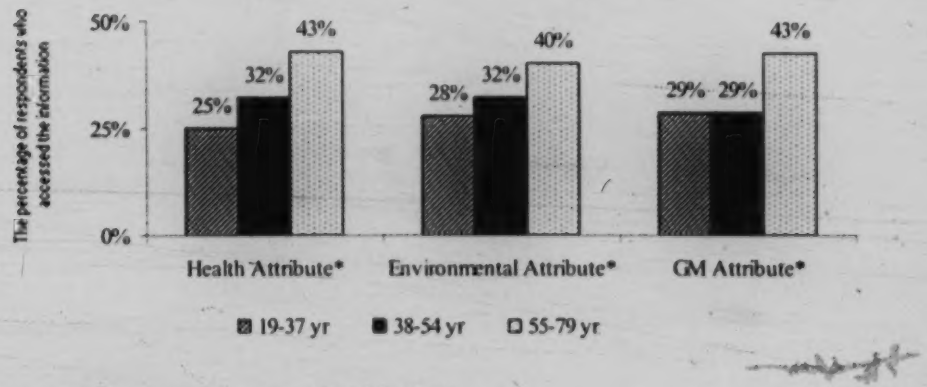
The respondents' actual age in years was obtained from the survey; however we simplify the analysis by dividing all respondents into three groups of approximately equal numbers. Respondents between the ages of 19 to 37 were included in the first group and

[11] A Chi-squared test has been used to test on the significant difference of the proportions of different demographic categories listed in Figure 4-9 to Figure 4-16 by SPSS and the Chi-squared test results are listed in Appendix 3.2.

are described as "young in age" with the number of 143 respondents in the group. Respondents between the ages of 38 to 54 are categorised in the second "middle-aged" group which includes 155 respondents. Respondents in the third group were relatively older, having 131 respondents in number with age ranging from 55 to 79 years of age.

Cross tabulation (Figure 4-10[12]) shows that members of the older age— the third group—tended to seek information more (on any of the health, environmental and GM attributes of the product) than was the case for the members of the young and middle-aged groups.

Figure 4-10: The Effect of Age on Information Search Behaviour



* represents the significant proportions, see Appendix 3.2 for details.

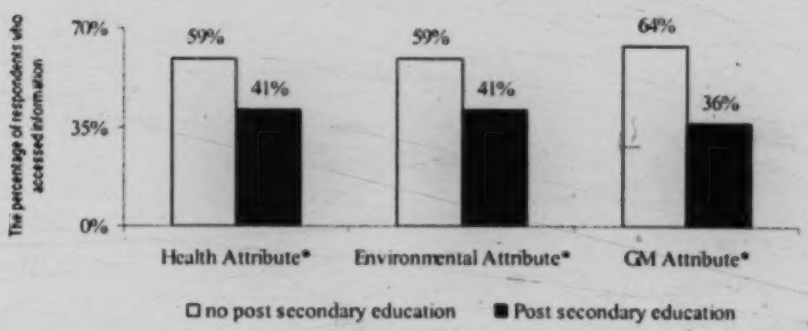
Younger people tended to access information on any of the topics least amongst the three age groups, with the GM/GE attribute as their favourite. Middle-aged respondents showed similar interests in accessing the health and environmental information, but accessed the GM information slightly less.

4.2.5.3 *Education Level*

[12] Please consult Appendix 9 for the actual numbers of respondents in each of the age groups who accessed different types of information.

In the original questionnaire, levels of education were scaled into 10 detailed choices from "Never attended school" to "Post graduate university degree (e.g., Master or Ph.D.). For simplification, we divide the sample into two substantial groups: people with relatively less education, numbering 282 out of 445, versus those respondents with a university undergraduate degree and above as the second group which numbers 161 out of 445. Figure 4-11[13] shows the association between education level and respondents' information access behaviour. The first column represents the percentage of people that accessed the attribute information with lower education. The second column shows the portion of people with higher education seeking attribute information for the product.

Figure 4-11: The Effect of Education on Information Search Behaviour



* represents the significant proportions, see Appendix 3.2 for details.

4.2.5.4 *Income*

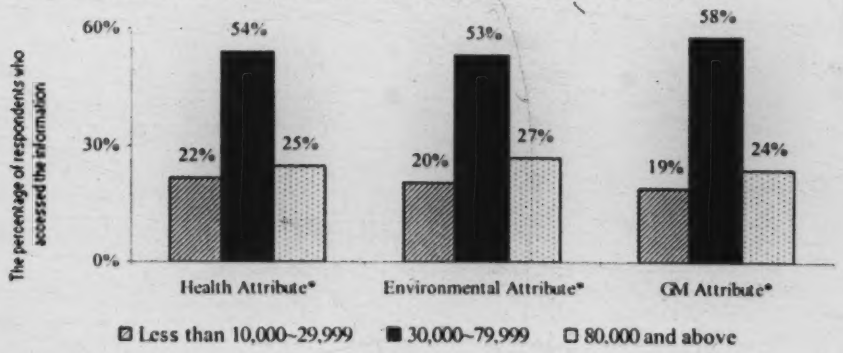
The questionnaire that is the source of the data for this study queried respondents as to their income levels in terms of total household income before taxes, scaled into 11 income ranges from "Less than $10,000" to "More than $100,000" with 10,000 as the basis of the intervals. For this analysis the income responses are simplified by dividing

[13] The actual numbers of respondents in each of the educational groups who voluntarily searched different types of information are presented in Appendix 8.

the sample into three groups: lower (total household income before taxes in the range of less than 10,000~29,999), middle (total household income before taxes in the range of less than 30,000~79,999) and higher income (total household before taxes in the range of less than 80,000 and above) groups. Figure 4-12[14] depicts the association between respondents' household income and their information search behaviour on the three attributes of the product. The figure shows that a higher percentage of the middle-income group accessed information than for the other two groups.

This is not consistent with our hypothesis, expressed in Section 3.3, Chapter 3, that income and information search are negatively related. It is possible that income may have an inverted U-shape relationship with information.

Figure 4-12: The Effect of Income on Information Search Behaviour



* represents the significant proportions, see Appendix 3.2 for details.

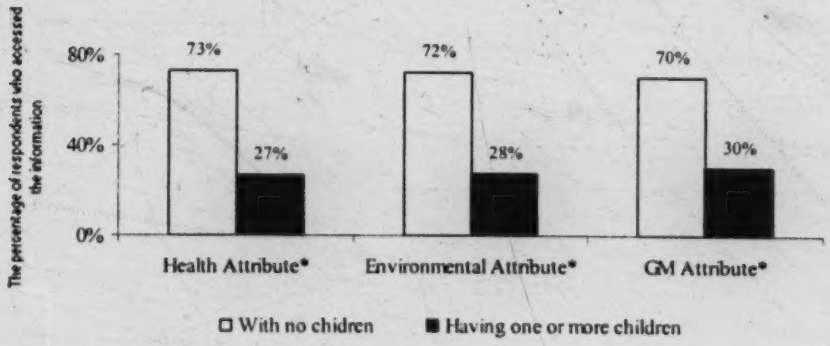
4.2.5.5 *Number of Children*

The survey sample can be divided into two groups relative to the number of children in the households in the sample. These are families without children (258 out of

[14] Please consult Appendix 8 for the actual numbers of respondents who sought for different types of information in each of the income categories.

445) and families with one or more children (180 out of 445). Figure 4-13[15] shows the association between the number of children in the household and respondents' information search behaviour on the three attributes of the product. Contrary to expectations, respondents with no children demonstrate much more interest in accessing information on all the topics; this may reflect a scarcity of time for respondents with children.

Figure 4-13: The Effect of Number of Children on Information Search Behaviour



* represents the significant proportions, see Appendix 3.2 for details.

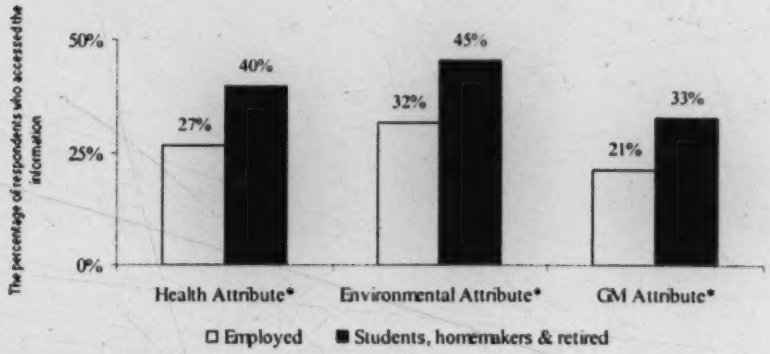
4.2.5.6 *Employment Status*

The measure applied here includes two groupings. One is described as "Employed", and includes people working full- or part-time, numbering 272 respondents. The second grouping includes 157 respondents, including respondents who were full- or part- time students, homemakers and retired. Figure 4-14[16] indicates that compared to the group of those respondents who may have had more spare time, the employed respondents sought less information on any of the three attributes of the product. This is

[15] The detailed information of the number of respondents who accessed information is presented under the category of "Number of Children" in Appendix 8.
[16] Please consult Appendix 8 for the actual number of respondents who sought for information under each of the employment status catalogues.

compatible with the hypothesis of a negative relationship between the opportunity cost of time and consumer information search behaviour.

Figure 4-14: The Effect of Employment Status on Information Search behaviour



* represents the significant proportions, see Appendix 3.2 for details.

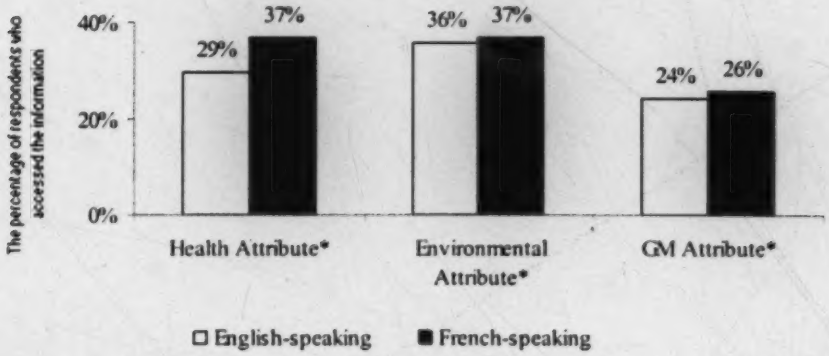
4.2.5.7 *Language*

In the cross-Canada survey, the respondents interviewed could respond in either English or French, reflecting the portion of the sample whose first language is French. In our sample, 77% of the respondents (343 of 445) are English-speaking with 23% of the respondents (102 of 445) having French as their mother tongue. From Figure 4-15[17], it is seen that the French-speaking respondents more frequently accessed the health attribute information for the product than did the English-speaking respondents. For the environmental and GM attributes of the product, both English- and French-speaking

[17] The number and percentages of respondents accessing different types of information regarding their language is presented in Appendix 8.

respondents showed a similar rate of accessing information.

Figure 4-15: The Effect of Language on Information Search Behaviour

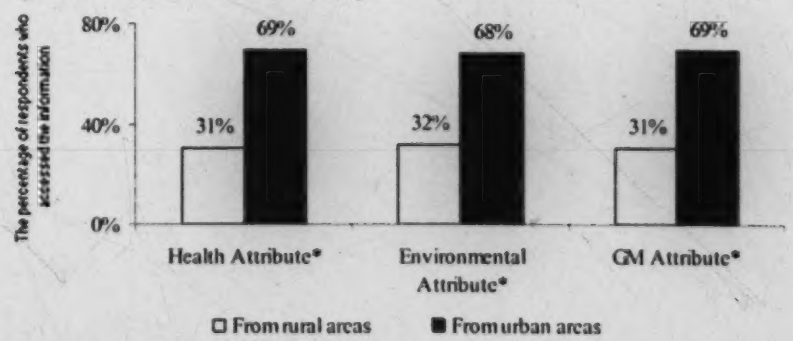


* represents the significant proportions, see Appendix 3.2 for details.

4.2.5.8 *Place of Residence*

Two variables describe respondents' place of residence, one of which is whether a respondent is from an urban or rural area. The other residence measure is the province in which a respondent resides. In our sample, 160 respondents are from rural areas (36% of 445), and 280 are from urban areas (63% of 445). The descriptive data in Figure 4-16 show that respondents from urban areas more frequently sought information on each of the three attributes of the product than those residing in rural areas.

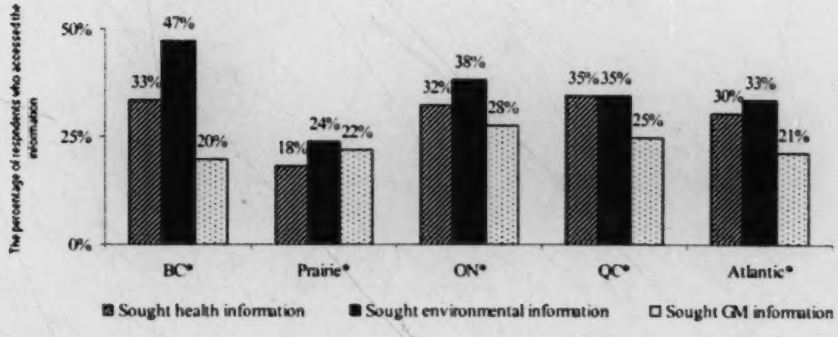
Figure 4-16: The Effect of Residency Place on Information Search Behaviour



* represents the significant proportions, see Appendix 3.2 for details.

Relative to the respondents' province of residence, Figure 4-17 [18] shows differences in information search behaviour of the respondents from different provinces. In this comparison the country is divided into five provincial groups: British Columbia (BC), Prairie Provinces (AB, SK, and MB), Ontario (ON), Quebec (QC), and the Maritime Provinces (NS, NB, PEI, and NF).

Figure 4-17: The Effect of Reginal Variation on Information Search Behaviour



* represents the significant proportions, see Appendix 3.1 for details.

Quebec respondents tended to access more information on the topics relating to the health attribute of the product. BC residents showed more interest in accessing the information on the environmental attribute of the product. Generally, Prairie province residents were the least inclined to access any of the attribute information of the product.

[18] The actual number of respondents accessing different types of information regarding their place of residence and province (Figure 4-16 and Figure 4-17) is provided in Appendix 8.

5 ECONOMETRIC MODEL SPECIFICATION AND ESTIMATION RESULTS

5.1 Discrete Choice and Random Utility Model

Discrete choice theory relates to the choice situations where a decision maker draws a choice from a non-empty set of mutually independent and collectively exhaustive alternatives and consumption of one or more commodities is required to be zero (Ben-Akiva and Lerman,1985). Following this body of theory, it is expected that an Alternative *i* will be chosen over another *j* if the utility associated with *i* is greater than utility from Alternative *j*. In general, utility is postulated as a function of the cost of the alternative, its attributes and the characteristics of the decision maker relative to preferences, perceptions and socio-economic environment (Ben-Akiva and Lerman,1985).

An individual is always assumed to select the alternative with the highest utility, but the precise level of utility arising from any given alternative is not known to the analyst with certainty. As a result, Ben Akiva and Lerman suggested that a random component may be associated with the observed household choices (Ben-Akiva and Lerman,1985). The systematic component of utility is a function of observable attributes of commodities and individual characteristics, while the random component captures variations in choice due to within- and between-individual variance, omitted variables, measurement errors and imperfect information (Manski, 1977). As a result, probabilistic choice concepts are applied to explain consumer behaviour, such as in random utility models (Train,1985).

The random utility model assumes that a consumer, *n*, receives utility, U_{ni}, from choosing a choice alternative *i* from a finite set of choices, *C*. The individual's utility of

choice is equal to $U_{ni} = U(x_{ni}, s_n)$, where x_{ni} is a vector of specific attributes of choice alternative i as experienced by individual n, and s_n is a vector of individual-specific characteristics, such as attitudes, perceptions and demographics.

Standard random utility theory suggests that an individual's utility function consists of deterministic utility component, derived from the observable attribute vector x_{ni} of a specific choice alternative i, and a stochastic component, ε_i, which captures the unobservable component of utility (Ben-Akiva and Lerman,1985). This relationship is typically represented as

$$U_{in} = V_{in} + \varepsilon_{in} \qquad (5.1),$$

where $V_{in} = f(x_i, s_n)$ is the indirect utility function associated with the observable attribute vector of choice alternative i. In random utility theory, the expected utility of a good is viewed as a function of the attributes of the good, the relevant characteristics of the decision maker and some random component. The choice of an alternative i is one of a finite set of alternatives in the household's choice set C_n. This can be demonstrated as follows:

$$P_n(i|C_n) = P_r[U_{in} \geq U_{jn}, \forall j \in C_n] \qquad (5.2),$$

in which U_{in} is person n's utility of choosing Alternative i, V_{in} is the observable component of utility, and ε_{in} is a random component. If Expression 5.1 is substituted into Expression 5.2, the latter can be written as:

$$P_n(i|C_n) = P_r[V_{in} + \varepsilon_{in} \geq V_{jn} + \varepsilon_{jn}, \forall j \in C_n] \qquad (5.3).$$

The random component is assumed to be independently and identically distributed (IID) according to a particular probability distribution (Ben-Akiva and Lerman,1985). As

pointed out by Ben-Akiva and Lerman, the assumption of IID random errors results in a simple scaleable model where the choice probability of an alternative i is only a function of the differences:

$$V_{in} - V_{jn}, j \neq i, j \in C_n$$

V_{in} is assumed to have a linear form:

$$V_{in} = \beta' x_{in} + \alpha_j' x_n + \varepsilon_{in} \qquad (5.4),$$

where x_{in} is a matrix of attributes of the alternative i influencing choice experienced by the nth household, β is a vector of coefficients for these attributes, x_n is a matrix of individual –specific characteristics of the household that may influence the choice of i and α_j are vectors of coefficients of the individual-specific characteristics for each of the j alternatives. To obtain a specific operational random utility model (RUM), an assumption must be made about the joint probability distribution of the full set of error terms (Ben-Akiva and Lerman,1985).

In our study, the model that is applied can be seen as a variant of random utility model. V_{in} is the indirect utility function associated with the respondents' utility from seeking information, that is, whether or not a respondent clicks the hyperlinks provided: the indirect utility of clicking the hyperlinks *V (Click)* versus the indirect utility of not clicking *V (Not clicking)*. Thus whether or not the individual clicks the hyperlinks with regard to GM and related information reflects the benefits and costs of this information search for that respondent. Consequently, clicking behaviour may be viewed to be a function of the costs of information search, the benefits of information search, the relevant characteristics of consumers (consumers' perceptions, attitudes toward GM and

their demographic information) and some random component. This is pursued through binary logit models.

5.2 Binary Logit Model

To explain consumers' voluntary access to information, a model with the standard binary logit structure was postulated to define the relationships between respondents' information search behaviour and their specified attitudinal, perceptional, and socio-economic characteristics, as previously discussed. As the simplest probability model, binary logit models have only two categories in each response variable – event A or non-A—which measure the occurrence and non-occurrence of events and behavioural patterns. Accordingly, the occurrence and non-occurrence of the postulated explanatory variables are the two categories of the dependent variable. The dependent variable adopted in this study is a 0-1 dummy variable. Specification of "0" represents that a consumer did not click the provided hyperlinks to search for more information while "1" denotes the opposite situation of accessing information. When the random component of the response is assumed to follow a binomial distribution, one can further assume the logistic distribution for the difference between ε_{in} and ε_{jn} (Liao, 1994). According to Liao, a binary logit model usually takes two forms, which can be expressed either in terms of the logit form or in terms of event probability. If it is expressed in logit form, the model is specified as

$$\text{Log}\left[\frac{P(y=1)}{1-P(y=1)}\right]=\sum_{k=1}^{k}\beta_k x_k \qquad (5.5).$$

Equation (5.5) can be transformed into a specification of the logit model of event probability as:

$$\text{Prob (y=1)} = 1 - L\left[-\sum_{k=1}^{k}\beta_k x_k\right] = L\left[\sum_{k=1}^{k}\beta_k x_k\right] = \frac{e^{\sum_{k=1}^{k}\beta_k x_k}}{1+e^{\sum_{k=1}^{k}\beta_k x_k}} \qquad (5.6),$$

which represents the probability of an event occurring. L is the logistic distribution function. For a non-event, the probability is one minus the event probability or;

$$\text{Prob (y=0)} = L\left[-\sum_{k=1}^{k}\beta_k x_k\right] = \frac{e^{-\sum_{k=1}^{k}\beta_k x_k}}{1+e^{\sum_{k=1}^{k}\beta_k x_k}} = \frac{1}{1+e^{\sum_{k=1}^{k}\beta_k x_k}} \qquad (5.7).$$

Many commercially available statistical/ econometric packages can conduct this routine estimation, like the computer program LIMDEP which is used in this study.

5.3 Discussion of Estimation Results

Since the focus of this thesis is the factors that influence respondents' information search behaviour on three different types of information supplied about the product (health, environmental, and/or GM attribute information), four different sub-binary logit models are postulated, each with a different dependent variable in the respective model. The first dependent variable is: "Any info." (A 0-1 dummy variable, where 1 describes where a respondent clicked at least one of the hyperlinks in the topics about the three attributes of the product, and 0 describes that none of the topics was accessed), which indicates whether or not a respondent clicks any hyperlinked information. The second dependent variable is termed "Any health info." (a 0-1 dummy variable, where 1 describes whether a respondent clicked on either of the hyperlinks in the health attribute topics, (described as Topic 1 or Topic 2), and 0 indicates that none of these two topics was accessed.), showing respondents' information search on the health attribute topics. Topic 1 and Topic 2 in the survey were "To find out more information on the vitamins in

the bread" and "Why vitamins are important". The third dependent variable is termed "Any envi. info." (a 0-1 dummy variable, where 1 describes that a respondent clicked on either of the hyperlinks in the environmental attribute topics (described as Topic 3 or Topic 4), and 0 describes that neither of these two topics was accessed.), showing respondents' information search on the environmental attribute topics. Topic 3 represented the topic to find "why this product is environmentally friendly" and Topic 4 provided information on the question "why is reducing herbicide in agriculture important?" The last dependent variable is termed "Any GM info." (a 0-1 dummy variable, where 1 describes whether a respondent clicked on either of the hyperlinks in the GM attribute topics (described as Topic 5 or Topic 6), and 0 describes that none of these topics was accessed), showing respondents' information search on the GM attribute topics. Topic 5 showed "Whether GM/GE foods are safe to eat" and Topic 6 offered information on "environmental effects of GM crops" respectively.

Two sets of explanatory variables are applied in the regression models, one of which includes demographic variables, while the other includes both demographic variables and attitudinal and perceptional variables discussed in Chapter Three. As a result of this design, eight models are specified (Consult Table 5-1 for details).

Table 5-1: The dependent and independent variables adopted in the first two sets of models

		Dependent Variable	Independent Variables
Model Group 1	Model 1.1	Any info.	Demographic variables
	Model 1.2	Any health info.	Demographic variables
	Model 1.3	Any environmental info.	Demographic variables
	Model 1.4	Any GM info.	Demographic variables
Model Group 2	Model 2.1	Any info.	Attitudinal, perceptional and demographic variables
	Model 2.2	Any health info.	Attitudinal, perceptional and demographic variables
	Model 2.3	Any environmental info.	Attitudinal, perceptional and demographic variables
	Model 2.4	Any GM info.	Attitudinal, perceptional and demographic variables

5.3.1 Model Group 1:

Parameter estimates were obtained by using the computer program LIMDEP Version 7.0 (Greene, 1995). The estimated coefficients for Model Group 1 are presented in Table 5-2. In order to accurately estimate the roles of the variables on search behaviour, different combinations of demographic variables were used for each of the dependent variables. Because of their insignificant estimated coefficients, several of the demographic variables previously discussed were omitted in the final version of the models, given here.

Table 5-2: Parameter estimates for binary logit models explaining the probability of searching for more information as a function of demographics explanatory variables, by type of information searched (Model Group 1).

	Model 1.1: Any info.	Model 1.2: Any health info.	Model 1.3: Any envi. info.	Model 1.4: Any GM info.
VARIABLE NAME	Coefficient (T-ratio)	Coefficient (T-ratio)	Coefficient (T-ratio)	Coefficient (T-ratio)
CONSTANT	1.044019 (0.943)	-0.1887105 (-1.025)	7.40E-02 (0.409)	0.621472 (0.517)
MALE	-0.49438** (-2.379)	-0.2735744 (-1.223)	-0.379076* (-1.754)	-0.518714** (-2.158)
CHILD	-0.23371** (-2.241)	-0.3402256*** (-3.094)	-0.322567** (-3.13)	-0.219056* (-1.735)
URBAN	0.388141* (1.816)	N. A.	N. A.	N. A.
AGE	-6.10E-02 (-1.202)	N. A.	N. A.	-7.78E-02 (-1.436)
AGE SQUARED	7.83E-04 (1.426)	N. A.	N. A.	9.68E-04* (1.676)
EMPLOY. STATUS	N. A.	-0.388403 (-1.745)	-0.376174* (-1.741)	N. A.
Log likelihood function	-274.355	-255.1307	-268.5873	-231.4249
Restricted Log-Likelihood function	-287.767	-264.511	-278.9249	-240.3079
Chi-Square (χ^2)	26.82365	18.76047	20.67537	17.76605
Adjusted ρ^2	0.046606	0.0354628	0.037062	0.036965

Note: * denotes significance at the α = 0.10 level ** denotes significance at the α = 0.05 level
*** denotes significance at the α = 0.01 level

Table 5-2 reports estimated coefficients for Model 1.1 to Model 1.4 in which the demographic variables are used as explanatory variables in estimating respondents' information seeking behaviour on the various attributes of the bread product. According to the significance of the variables, the final version of Model 1.1 (which is postulated to explain access to any information) includes the alternative-specific constant, respondents'

gender, age, squared form of age, number of children and place of residence[19]. In Model 1.2 and Model 1.3, which explain consumer information search on the health and environmental attributes of the product respectively, the variable "EMPLOY. STATUS", which has a significant coefficient, is included in the basic model, along with the alternative-specific constant, respondents' gender and number of children in the household. The last model of this group (Model 1.4) which is postulated to explain access to GM information, includes the alternative-specific constant, respondents' gender, number of children, age and squared form of age as the explanatory variables.

In Model 1.1, the estimated coefficient of "MALE" is significant and negative, showing male respondents were less likely to access any information on the attributes of the product than were females. The variable "CHILD" has a negative and significant coefficient, indicating that respondents with no children tended to search more for product information than those having one or more children in the household. The coefficient for the variable "URBAN" is positive and significant. Respondents living in urban areas were more likely to access attribute information in general than were those living in rural areas. In Model 1.2, the coefficient of "CHILD" is also negative and significant, indicating that respondents with children were less likely to access the health attribute information for the product than were those respondents with no children in the household. Another variable with a significant negative coefficient is "EMPLOY. STATUS". Employed respondents were less likely to access health attribute information on the product than students, the retired and homemakers, who may have more spare time. In Model 1.3, three variables are estimated to be significantly influencing respondents'

[19] The estimation result for the variable "province of residence" was not included in the final analysis since the estimated parameter for the variable was insignificant.

information search behaviour on the environmental attribute of the product: "MALE", "CHILD" and "EMPLOY. STATUS"; the relationships of these variables with information search are all negative, showing that employed male respondents with one or more children in the family were less likely to access information about the environmental attribute of the product. With Model 1.4, the coefficients of "MALE", "CHILD" and "AGE SQUARED" are significant, with the first two variables having a negative sign on the coefficients and the last having a positive sign. Male respondents with children in the family tended to search less information on the GM attribute of the product.

The hypothesized negative relationship between gender and external search is compatible with our results. A significant and negative estimated coefficient for the variable MALE is obtained from three of the four models in Model Group 1, indicating that male respondents were generally less likely to seek information on attributes of the bread product than were female respondents. The coefficients for AGE are not significant in Model 1.1 and Model 1.4. The squared form of age is only significant and positive in Model 1.4. CHILD is significant and negative in each of the four models. Respondents with no children were more likely to access the various types of information, particularly information on the health attribute (at a significance level of 0.001), than were respondents with children in the household. The coefficient on URBAN is significant and positive in Model 1.1. Respondents living in urban areas were generally more likely to click the hyperlinks to access any information than were those living in rural areas. The coefficient of EMPLOY. STATUS is significant and negative in both Model 1.2 and Model 1.3. Employed respondents (working full- or part-time) were less

likely to access health and environmental attribute information of the product than were students, homemakers and retired people. Socio-demographic considerations hypothesised as important, like consumers' education level and household income did not show up as significant factors that influenced information search behaviour. This might be caused by correlation between demographic variables or biased sampling of our study, or because these factors were not in fact important to information search in the context of this study.

5.3.2 Model Group 2:

The second set of models analysing respondents' information seeking behaviour include attitudinal and perceptional variables that are hypothesised as measures of consumer-level assessments of benefits and risks of information search, as discussed in Chapter Three. Attitudinal and perceptional variables included in these models proxy people's risk perceptions of GM food, their objective and subjective knowledge on GM technology, and their assessment of the credibility of information sources, as well as their attitudes toward GM foods. The results from estimation of this set of models are given in Table 5-3. Relative to the hypothesised variables that best explain respondents' information search behaviour on the three attributes of the product, different combinations of explanatory variables are seen as determinants of the four different dependent variables, which again indicate whether or not respondents accessed any information (Model 2.1), or information on the health attribute of the product (Model 2.2) or information on the environmental attribute of the product (Model 2.3) or information on the GM attribute of the product (Model 2.4). The estimated results for the variable MALE are significant and negative in all the models except in Model 2.2 (where the

dependent variable is whether the respondents accessed the health attribute information for the product), indicating that female respondents were more likely to access this type of information than were male respondents. Again the variable CHILD is significant and negative in each of the four models with a significance level of $\alpha = 0.01$ in Model 2.2, which shows that the number of children in the household is an influential explanatory variable in explaining consumer information search. The estimated coefficients of variable FDIND are significant and negative in all models of the set except in Model 2.4, which indicates that the distrust in the food industry has a significant, positive influence on the probability that respondents accessed information on the health and environmental attributes, but not on the GM information.

It is seen that for Model 2.3, in which the dependent variable is whether or not respondents sought information on the environmental attribute of the product, estimated coefficients for variables HWINFORM, SHRISK, and ATTITUDE[20] are all significant, which is not the case in the other models. The estimated coefficient for HWINFORM is significant and positive, indicating that people were more likely to access the environmental attribute information if they considered that they were well informed about GM/GE food products. People who felt well informed about GM seemed to choose to examine environmental information—perhaps because the marginal benefits of environmental information were greater than GM information to them. In our consideration of the nature of the attitudinal variables on information access, we hypothesise that consumers' subjective knowledge of GM technology might have either a

[20] Variables HWINFORM, SHRISK, and ENVIRISK represent respondents' subjective knowledge on GM technology and foods, respondents' perception of risk on food safety & health and respondents' positive & neutral attitude toward application of GM/ GE in food production respectively.

positive, a negative or no relationship with information search. The results given in Table 5-3 indicate that consumers' subjective knowledge is positively related to information search, that is, a high self-assessment of knowledge, which is the basis of subjective knowledge, appears to be associated with a tendency to search for environmental information in the context of this study. This finding of a positive relationship between subjective knowledge and information search is consistent with the observation by Schmidt and Spreng (1996) that "higher levels of subjective knowledge increase one's perceived ability to engage in external search in information" (p.249).

Table 5-3: Parameter estimates for binary logit models explaining the probability of searching for more information as a function of demographics, perceptional and attitudinal explanatory variables, by type of information searched (Model Group 2).

	Model 2.1: Any Info.	Model 2.2: Any health info.	Model 2.3: Any envi. info.	Model 2.4: Any GM Info.
VARIABLE NAME	Coefficient (T-ratio)	Coefficient (T-ratio)	Coefficient (T-ratio)	Coefficient (T-ratio)
CONSTANT	1.240297 (1.087)	-5.35E-02 (-0.265)	-0.125106 (-0.461)	0.492907 (0.406)
MALE	-0.50342** (-2.382)	-0.2970865 (-1.309)	-0.485023** (-2.140)	-0.509232** (-2.088)
CHILD	-0.22584** (-2.151)	-0.3227536*** (-2.913)	-0.282688** (-2.696)	-0.214018* (-1.679)
URBAN	0.373894* (1.729)	N. A.	N. A.	N. A.
AGE	-6.09E-02 (-1.176)	N. A.	N. A.	-8.06E-02 (-1.476)
AGE SQUARED	7.67E-04 (1.376)	N. A.	N. A.	9.98E-04* (1.712)
EMPLOY. STATUS	N. A.	-0.3571493 (-1.58)	-0.392236* (-1.754)	N. A.
FDIND	-0.38584* (-1.822)	-0.3821469* (-1.70)	-0.512011** (-2.323)	N. A.
HWINFORM	N. A.	N. A.	0.523379** (2.367)	7.87E-02 (0.331)
SHRISK	N. A.	N. A.	5.59E-04* (1.820)	-1.06E-04 (-0.341)
ATTITUDE	N. A.	N. A.	-4.43E-04* (-1.953)	-2.07E-04 (-0.836)
Log likelihood function	-270.113	-251.4582	-258.154	-230.8964
Restricted Log-Likelihood function	-284.989	-262.2191	-276.5477	-240.3079
Chi-Square (χ^2)	29.75114	21.52192	36.78744	18.82296
Adjusted ρ^2	0.052197	0.04103782	0.066512	0.039164

Note: * denotes significance at the α = 0.10 level ** denotes significance at the α = 0.05 level
*** denotes significance at the α = 0.01 level

In the study by Urbany and his colleagues, respondents who were uncertain about their knowledge (i.e., having low subjective knowledge about the product) exhibited lower levels of search (Urbany et al., 1989), which is also compatible with our conclusion of a positive relationship between subjective knowledge and external search. Variable SHRISK is significant and positive, indicating that if a respondent perceives a high level of risks on food safety and health, s/he was more likely to click the hyperlinks to access information on the environment-related attribute. This estimation result is consistent with our hypothesis of a positive relationship between the level of perceived risk and information search. The coefficient on variable ATTITUDE is significant and negative, which can be interpreted as an indication that respondents with more positive attitudes toward the application of GM/GE in food production were less likely to access the information on the environmental attribute of the product.

5.3.3 Summary of estimation results

Gender, employment status, rural or urban residency, lack of children in the household, and the lack of trust that a respondent expressed in the food industry as an information source are factors found to significantly influence the probability that respondents would access information on particular topics. Female respondents, not working outside the home, without children in the household, and living in urban areas are the major socio-demographic characteristics of the people who voluntarily accessed information on the product. The fact that females were more likely to search information is consistent with our prior hypothesis that females are more inclined to search for information than males (Avery, 1996) and the recognition that women in general are more concerned with food safety (Li et al., 2002). Respondents who are employed are

less likely to access information than those who have more spare time, like students, homemakers and the retired, which is compatible with the hypothesis of a negative relationship between search and employment status (Punj and Staelin, 1983; Srinivasan, 1986; Urbany, 1986). Possible reasons for people with no children in the household tending to seek information may be that this group of people is more interested in this topic or that they have more time available with fewer children to care for. The tendency for people living in urban areas to seek more information relative to those in rural areas might possibly be explained as a result of effectiveness with which news spreads. It may be easier for urban people to obtain information from broadcasts, newspapers, internet, seminars, advertising, and even talks and chatting leading to more interest in accessing information. From the literature review, age was expected to be an important factor in the effort on information search behaviour, and it was assumed that younger people are more likely to seek information when compared with older people. In our study, the relationship between age and search behaviour, other factors held constant, is in the expected direction (negative), but with coefficients below statistical significance. Since the other socio-economic and demographic factors of education, income, residence of province, did not show significant estimation results in our regressions, they are not included among the explanatory variables in the final model estimations.

In general, in terms of their attitudinal and perceptional characteristics, people's responses to information seeking are consistent with the hypothesized concepts of benefits and costs. The estimated coefficients on variables reflecting respondents' trust in some information sources, including Canadian Government, family and friends, farmers' associations, research institutions and consumer associations, are not significantly

associated with information search. The only exception is the information source of the food industry. The significant negative coefficient on trust in information from the food industry in the models explaining respondents' information search behaviour shows that the respondents who did not assess the food industry to be trustworthy as an information source tended to seek more information about the product.

It is hypothesised in the early theoretical analysis of this study that perceptions of risk may have a positive relationship with consumer information search. When people perceive a risk, they may put more effort into seeking information, since this may reduce the uncertainty associated with the risk. In our study, the variable proxying consumers' risk perceptions of GM food is the respondents' perception of risk on food safety and health issues (the variable SHRISK). The estimated coefficient of SHRISK is only significant and positive in Model 2.3, which explains consumer information search about environmental attributes of the product. Respondents who viewed a high level of risk on possible food safety and health issues showed more of a tendency to voluntarily access information about the environmental attribute of the product. The significant relationship between respondents' risk perception and their information responses to the environmental attribute is not seen in the respondents' information responses to either the health or GM attribute of the product, which shows "risk perception", as a perceptional explanatory variable, better explains consumers' information search about the environmental attribute rather than the health and GM attribute information.

The estimation results also indicate that the variable representing consumers' subjective knowledge is significant and positive only in explaining respondents' information search behaviour on the environmental attribute, which shows that a high

self-assessment of knowledge on GM technology and products appears to be associated with the tendency to search information. This finding of a positive relationship between subjective knowledge and information search is consistent with the previous studies by Urbany et al. (1989) and Schmidt and Spreng (1996) that consumers' higher certainty about their subjective knowledge may lead to higher level of external information search and vice versa. Moreover, a significant negative relationship between consumers' positive attitudes toward GM foods and their information search for environmental attribute of the product is also seen in the analysis. It can be interpreted that respondents with more negative attitudes toward the application of GM/GE in food production were more likely to access information on the environmental attribute of the product. A possible reason why consumers holding a negative attitude to GM foods may search more for the environmental attribute information might be that these respondents viewed the effect of GM/GE foods on the environment to have the most direct impact on them. Their concern about this feature may have led these respondents to learn more about the environmental information.

6 CHOICE CONTEXT INFLUENCE ON INFORMATION SEARCH

6.1 The Overview of Literature Relating to "Choice Context"

In most of the empirical models of choice in the fields of economics and consumer research, it is assumed that the decision maker obtains acquaintance with all alternatives and information in a perfect information processing sense. Factors like complexity of the choice environment, the effect of the choice context on the decision strategy as well as the ability of the individual to make complex decisions, are generally not considered in statistical model development (Swait and Adamowicz, 2001). Srinivasan and Ratchford have argued that aspects of the environment (e.g., difficulty of the choice task, number of alternatives, and complexity of the alternatives) should be included in developing typologies of consumer information search strategies (Srinivasan and Ratchford, 1991). Heiner argued that the complexity and uncertainty surrounding choice situations usually leads consumers to adopt simplified strategies and suggested that more effort should be expended to understand the role that complexity plays in choice behaviour (Heiner, 1983). One of the reasons for "the neglect of complexity in most analyses", explained by Swait and Adamowicz, is that "theoretical literature on choice complexity and imperfect ability to choose that has developed in psychology and *behavioural decision theory* (BDT) literatures has not been translated into empirical econometric analysis" (Swait and Adamowicz, 2001).141). Another reason for neglect of complexity may be that the data used in economics and consumer research studies tend to be somewhat different from the data structures used in psychology and *behavioural decision theory* (BDT) (Swait and Adamowicz, 2001). Swait and Adamowicz also argued that the introduction of elements from the field of psychology into economic consumer

behaviour study will lead to better reflection of actual judgement and decision processes in econometric models and researchers in psychology could transfer their knowledge and findings to the economic/consumer research literature (Swait and Adamowicz, 2001).

Furthermore, previous researchers have shown how they expect the complexity of the choice context to affect choice and demand. It is suggested that the choice complexity might lead to richer information on preferences as respondents put more effort into information processing when the complexity of choice increases (Payne, Bettman, and Johnson,1993). However, other researchers saw contradictory results that when choices are complex, people may deliberately avoid conflict and difficult trade-offs (Dhar, 1997). From the review above it is expected that various aspects of choice context may have an effect on consumer choice behaviour and the relationship between choice context and consumer choice behaviour could be either positive or negative.

6.2 Design of Choice Context in Our Study

According to the special design of choice tasks in our survey, it is reasonable for us to raise questions on the possible effect of choice context on consumer information search behaviour. For this, it is necessary to consider the choice task design, which is closely related to the choice context. In this online survey, as briefly introduced in Chapter Four, every respondent was assigned to a choice task, in which three purchase options (Options A-C) for pre-packaged bread were presented. The respondents were asked to indicate their preferred choice and only one option was allowed to be chosen. The first option (Option A) was the respondents' previously specified favourite bread. Option B was an alternative hypothesised bread product. This included a new specified

environmental and/or health attribute which could be specified to result from genetic modification. Option C gave the respondent the option not to purchase any bread at all.

Three possible new attributes might appear in Option B: a health attribute, an environmental attribute, and a GM attribute of the product. Since the three attributes of the product may or may not be presented in Option B simultaneously the choice tasks may vary in appearance in different choice task versions. According to the design of the survey, if 'Health attribute' is presented, "Rich in healthy vitamins" appears in Option B. If 'Environmental attribute' is presented, "Produced environmentally friendly" appears in Option B. If 'GM attribute' is presented and 'Health attribute' **or** 'Environmental attribute' is also presented, the box below appeared below the choice grid:

> ***More on the new feature(s) of this bread:***
> *Option B's additional features are a result of genetic modification/engineering of the wheat.
>
> Genetic modification, sometimes also called genetic engineering, is a recent development in modern biotechnology. This technique involves the transfer of a piece of genetic material from one organism to another. Through genetic engineering it is easier to introduce new traits without changing other traits in the plant or animal. It is also possible to introduce traits from outside the species, something that is not possible with traditional breeding methods.

If 'GM attribute' is presented but both the 'health attribute' **and** 'environmental attribute' are **absent**, the box below appeared below the choice grid:

> Option B is made with genetically modified/engineering wheat:
>
> Genetic modification, sometimes also called genetic engineering, is a recent development in modern biotechnology. This technique involves the transfer of a piece of genetic material from one organism to another. Through genetic engineering it is easier to introduce new traits without changing other traits in the plant or animal. It is also possible to introduce traits from outside the species, something that is not possible with traditional breeding methods.

We call both of the boxes listed above the ***GM information box***. Whenever 'GM attribute' is present, a GM information box will appear. Depending on whether 'health attribute' and/or 'environmental attribute' may appear, the GM information box differs slightly (i.e. only in its first line, as shown above).

As discussed in Section 4.1, "Introduction to the Survey" of Chapter Four, a special feature of this study is that it made additional product information voluntarily available to consumers. This feature of voluntary access to information was made possible by information hyperlinks. In the survey, another box with hyperlinks appears below the choice grid:

- If the 'health attribute' was present, the following two topics appeared[21]:

Topic 1: "To find out more about the vitamins in this bread, please click here."
Topic 2: "To learn why vitamins are important, please click here."

- If 'environmental attribute' is present, the following two topics appeared[22]:

Topic 3: "To find out why this product is environmentally friendly, please click here."
Topic 4: "Why is reducing herbicides in agriculture important? Please click here."

- If GM attribute is present and respondents have been assigned to Scenario 2 to 7, the following two topics appeared[23]:

Topic 5: "To find out whether genetically modified/engineered foods are safe to eat, please click here."
Topic 6: "To find about environmental effects of genetically modified crops, please click here."

[21] Topic 1 and Topic 2 relate to the possible health attribute of the product.
[22] Topic 3 and Topic 4 provide information on the possible environmental attribute of the product.
[23] Topic 5 and Topic 6 focus on a possible GM attribute of the product

The hyperlinks within the six information statements should result in a separate window opening with the appropriate information. A couple of points need to be mentioned here. First, if a respondent accessed the information hyperlinks for GM attribute of the product in Topic 5 and Topic 6, the information a respondent saw in the separate window may vary either in information source (generic or specific) or in information content (positive and/or negative), depending on the scenario version he/she has been assigned to at the beginning of the survey. In total, seven scenarios were offered with Scenario 1 having no information statements about the GM attribute of the product provided. Thus, if a respondent was assigned to Scenario 1, no opportunity to access attribute information would be provided under the grid on the choice task interface. The specified content of different versions of GM information scenarios is listed in the following table (Table 6-1).

Table 6-1: Specification of content and source for different GM information scenarios

	Generic	Specific
Positive	Scenario 2	Scenario 5
Negative	Scenario 3	Scenario 6
Both	Scenario 4	Scenario 7
Scenario 1: no information statement (none of the above is provided)		

Table 6-1 provides detailed information about the particular content (positive and/or negative) and source (generic or specific) for each of the seven GM information scenarios. For the other four topics (i.e., Topics 1 to 4, which relate to health and environmental attributes of the product), identical information was provided in a separate window for those who voluntarily searched for information. Based on the description of the design of choice task, the possible versions of the choice tasks that may be faced by the respondents are summarised in Table 6-2:

Table 6-2: Different versions of information presentation in the choice tasks

Versions	Attribute presented	Assigned GM Scenario	No. of Topics presented (i.e., No. of hyperlinks)	GM information box[24]
1	GM attribute	1	0	present
2	GM attribute	2-7	2	present
3	-health attribute	N.A.	2	absent
4	-environmental attribute	N.A.	2	absent
5	- GM attribute and health attribute	1	2	present
6	- GM attribute and environmental attribute	1	2	present
7	- GM attribute and health attribute	2-7	4	present
8	- GM attribute and environmental attribute;	2-7	4	present
9	-health attribute **and** environmental attribute;	N.A.	4	absent
10	-GM attribute **and** health attribute **and** environmental attribute;	1	4	present
11	-GM attribute **and** health attribute **and** environmental attribute;	2-7	6	present

Overall, the appearance of a possible choice task a respondent faced in the experiment was one of the versions listed above. The health and environmental attributes would either be present or absent in the choice task. The GM attribute inclusion is more complex in that this related to consideration of different information scenarios the respondents had been assigned to and the presence/absence of the "GM information box". As indicated in Table 6-2, a total of 11 choice tasks were available in total within the

[24] The information about "GM information box" is outlined on Page 74.

experiment. Since the context of different scenarios may vary, this feature could cause the appearance of the choice tasks to look dramatically different. Take Version 3 versus Version 11 as an example, undoubtedly Version 11 looks much more complex and wordy than Version 3. Version 3 has only two hyperlinked information statements under the option grid, but for Version 11, six information statements (hyperlinks) are presented with an additional presentation of the "GM information box". These two versions of the choice tasks look different and respondents' perceptions of those two choice tasks may not be the same because of the way that this is presented. This leads us to question the possible effect of the appearance of the choice task on consumer information search.

We are not able to readily identify which of the possible 11 versions appeared in the choice tasks faced by each respondent, but can assess the differences between GM Scenario 1 relative to the rest of the scenarios (GM Scenario 2 -7). It is the case that the appearance of the choice tasks faced by respondents assigned to Scenario 1 is always simpler than those faced by respondents assigned to GM Scenarios 2 though 7. In the survey, a respondent does not have the chance to see the hyperlinked information statements about the GM attribute of the product if he/she has been assigned to GM Scenario 1. The versions listed in Table 6-2 randomly appear in the choice tasks face by different respondents, leading it to be possible to assess the effect of this feature of the context of the survey environment on consumer information search.

In order to assess this feature in the context of the current study, we construct a measure of choice context as the variable "scenario" and incorporate this into the analysis[25]. In Section 1, Chapter Six, it has been discussed that the relationship between

[25]The design of the survey required that only if a respondent has clicked the hyperlink offered in the information statements, could they see the information in different scenarios. Use of the variable

choice context and consumer choice behaviour could be either positive or negative. We hypothesize a negative relationship between the choice context variable and respondents' information search behaviour in this study. That is, when the choice context becomes more complicated, respondents were supposed to access the attribute information of the product, clicking hyperlinks less to the topics. By adding this scenario variable, which is a set of seven 0-1 dummy variables showing Scenarios 1-7, into the second set of econometric models (Model Group 2[26]), the third model set is obtained. The dependent and independents variables are listed in Table 6-3:

Table 6-3: The Dependent and Independent variables adopted in Model Group 3

		Dependent Variable	Independent Variables
Model Group 3	Model 3.1	Any info.	Attitudinal, perceptional and demographic variables as well as the choice context dummy variables "scenario";
	Model 3.2	Any health info.	Attitudinal, perceptional and demographic variables as well as the choice context dummy variables "scenario";
	Model 3.3	Any environmental info.	Attitudinal, perceptional and demographic variables as well as the choice context dummy variables "scenario";
	Model 3.4	Any GM info.	Attitudinal, perceptional and demographic variables as well as the choice context dummy variables "scenario";

6.3 Estimation Results of Choice Context Variable "Scenario"

In order to incorporate the choice context variable "scenario" into the econometric models, it is assumed that consumer information search is endogenously determined and influenced by the context of information scenarios. It is hypothesised that the respondents

"Scenario" to explain consumer information search behaviour seems to reverse the causality of accessing information and seeing information in different scenarios. However, the analysis on the possible effect of design of scenario on the appearance of choice tasks, does suggest that different scenario versions may have an "indirect" influence on consumer information search behavior.

[26] In the models outlined in Section 5.2, Chapter Five, we do not include the "context" element of the online survey into either the economic framework or the econometric models.

who were assigned to GM Scenario 2-7, compared with those assigned to GM Scenario 1, will engage in less information search. We include the dummy variable "scenario" (a set of seven 0-1 dummy variables showing Scenarios 1-7) along with perceptional, attitudinal and demographic variables used in the second group of models and the estimation results are shown in Table 6-4:

Table 6-4: Parameter estimates for binary logit models explaining the probability of searching for more information as a function of the choice context variable "Scenario" as well as demographics, perceptional and attitudinal explanatory variables, by type of information searched (Model Group 3)

	Model 3.1: Any info.	Model 3.2: Any health info.	Model 3.3: Any envi. info.	Model 3.4: Any GM info.
Variable Name	Coefficient (T-ratio)	Coefficient (T-ratio)	Coefficient (T-ratio)	Coefficient (T-ratio)
Constant	1.520878 (1.2820)	8.57E-02 (0.254)	0.544159 (1.463)	0.851533 (0.649)
MALE	-0.49233** (-2.2910)	-0.26328 (-1.144)	-0.44971* (-1.941)	-0.60012** (-2.371)
CHILD	-0.23876** (-2.2450)	-0.33791*** (-3.026)	-0.28663*** (-2.685)	-0.253* (-1.921)
URBAN	0.385108* (1.7580)	N. A.	N. A.	N. A.
AGE	-5.32E-02 (-1.0170)	N. A.	N. A.	-8.53E-02 (-1.463)
AGE SQUARED	6.96E-04 (1.2350)	N. A.	N. A.	1.07E-03* (1.716)
EMPLOY.STATUS	N. A.	-0.34997 (-1.528)	-0.46249** (-2.009)	N. A.
FDIND	-0.36089* (-1.6830)	-0.36234 (-1.595)	-0.47732** (-2.13)	N. A.
SHRISK	N. A.	N. A.	5.57E-04* (1.768)	-1.82E-05 (-0.056)
ATTITUDE	N. A.	N. A.	-5.11E-04** (-2.205)	-1.54E-04 (-0.597)
HWINFORM	N. A.	N. A.	0.577263** (2.548)	2.53E-02 (0.102)
SCENARIO2	-0.55719 (-1.4350)	-0.3825 (-0.949)	-1.01707*** (-2.579)	N. A.
SCENARIO3	-0.51749 (-1.3540)	7.90E-02 (0.206)	-0.54906 (-1.449)	-0.24351 (-0.605)
SCENARIO4	-0.53303 (-1.2830)	-0.15019 (-0.358)	-0.83844** (-2.015)	0.101986 (0.24)
SCENARIO5	-0.49947 (-1.2460)	4.02E-02 (0.099)	-1.08034*** (-2.58)	0.261896 (0.646)
SCENARIO6	-0.93596** (-2.3730)	-0.55958 (-1.366)	-0.94935** (-2.39)	-5.54E-02 (-0.138)
SCENARIO7	-0.15418 (-0.3700)	-0.10998 (-0.26)	-0.6382 (-1.526)	0.318861 (0.759)
Log Likelihood function	-266.5451	-249.3355	-252.912	-209.591
Restricted Log-likelihood Function	-284.989	-262.219	-276.548	-221.68
Chi squared	36.88781	25.76723	47.27176	24.17856

Note: * denotes significance at the α = 0.10 level ** denotes significance at the α = 0.05 level
*** denotes significance at the α = .01 level

Comparing the estimation results obtained in the third set of the models (presented in Table 6-4) to those from the second set of the models shown in Table 5-3, it

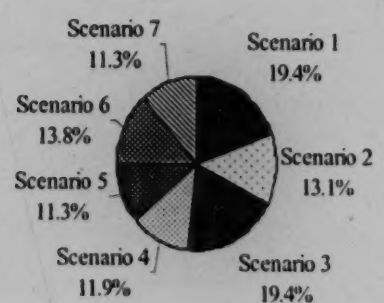
is found that the variables in Model Group 2 with significant estimation results still have significant coefficients in Model Group 3. Since "scenario" is a set of 0-1 dummy variables, in order to avoid multicolinearity, one variable must be omitted from the regression. The omitted dummy variable is "Scenario 1". In Model 3.1, the coefficients of the six scenario variables are all negative and below statistical significance except the coefficient for Scenario 6. A significant coefficient is obtained for Scenario 6 at the α =0.05 level. Thus, compared with the respondents assigned to Scenario 1, those assigned to Scenario 6 were in general less likely to search for any information. This is consistent with our hypothesis that respondents assigned to Scenario 2-7 are less likely to access information, compared to those assigned to Scenario 1. For the other scenario variables, Scenario 2, 3, 4, 5, 7, there are no significant estimation results in Model 3.1.

Model 3.2 explains consumer information search behaviour about the health attribute of the product. No significant estimation results were obtained for any of the scenario variables (Scenario 2-7), which can be an indication that consumer information search on the health attribute could not be explained by the information scenarios respondents were assigned to. That is to say, whether a respondent accessed the health information or not did not relate to the GM information scenarios he/she was assigned to. The difference between the appearance of choice tasks caused by GM Scenario 1 and the other Scenarios does not have an effect on consumer information search behaviour. The conclusion we draw here could also be extended to the point that if the respondents put a high value on the health attribute of the product, the choice context does not influence the respondents' information search for health information.

The estimation result of the scenario variables obtained in Model 3.3, which explain consumer information search behaviour on the environmental attribute of the product, it is very different from those obtained in Model 3.1 and Model 3.2. Among the 6 scenario variables, 4 variables have significant and negative coefficients (Scenario 2, 4, 5, 6). Only the coefficients for Scenario 3 and Scenario 7 are insignificant, but have negative signs. If a respondent was assigned to Scenario 2, 4, 5, 6, they were significantly less likely to click the hyperlinks for the environment-related information. This is compatible with the hypothesis of a negative relationship between the choice context variable "scenario" and respondents' information search behaviour.

There may be some possible reasons to explain why the coefficients of Scenario 3 and Scenario 7 are insignificant. We can check the information scenario distribution for the respondents who accessed the environmental attribute information of the product. The percentages of respondents accessing the environmental information from 7 different scenarios are given in Figure 6-1:

Figure 6-1: Scenario distribution for respondents who accessed the environmental information



The largest percentages of respondents who have accessed the environmental information were assigned to Scenario 1 and Scenario 3 (19.4%), indicating that compared with the respondents assigned to Scenario 1, respondents assigned to Scenario 3 showed equal interest in the environmental information—perhaps that explains why the coefficient of scenario variable for Scenario 3 is not significant. For Scenario 7, a possible reason for the insignificant estimation result might come from correlation with the demographic, perceptional and attitudinal variables also presented in the explanatory variables.

It seems from the results that when respondents had a chance to click the hyperlinks for the GM-related information (Scenarios 2-7), they were less likely to access environment-related information. Conversely, it seems that when respondents had a chance to click the hyperlinked GM-related information, their attention was drawn away from the environment-related information, so that they tended to click less on the hyperlinks to access environment-related information. This "diluting" effect of GM-related information on environment-related information was not observed on the health-related information, which may indicate that compared to health-related information, environment-related information was not as important.

In the last model of Model Group 3, Model 3.4, which assesses consumer information search on GM attribute of the product, the coefficient of Scenario 2 is not available in the estimation results. From the discussion earlier in this chapter, it is noted that for those who were assigned to Scenario 1, no information statements were presented in the choice tasks. As a result, those respondents who were assigned to Scenario 1 did not have a chance to click the hyperlinks in either of the GM attribute topics. Therefore,

in order to avoid perfect correlation between Scenario 1 and the constant, the data for those who were assigned to Scenario 1 are excluded in the regression of Model 3.4 and Scenario 2 is also omitted to avoid multicolinearity. None of the coefficients of the scenario variables are significant.

Because of the lack of data on the choice task versions respondents were particularly assigned to, we are unable to assess fully the possible effect of complexity of choice environment/choice context on consumer information search. From the econometric analysis presented above, the possibility of a relationship between scenarios/choice context and consumer information search behaviour exists. Two hypotheses can be deduced from the analysis above. Firstly, some kind of relationship may exist between choice context and consumer information search. Some researchers have proposed in their studies that when the choice tasks appear more complex, whether a consumer searches for more information or not may relate to the complexity of the choice environment, the effect of the choice context as well as the ability of the individual to make decisions (Heiner, 1983). Secondly, we find that when the scenario variables are introduced into the models, different estimation results are obtained for the models that are based on different dependent variables. The different effects of scenario variables in the four models of Model Group 3 could be an indication of respondents' diversified interests in different attribute information. The respondents may put a higher value on the health information than on the environmental attribute information of the product.

7 CONCLUSIONS AND DISCUSSTION

7.1 Summary of the Findings

This study is directed to explain the differences in information search behaviour among a sample of Canadian consumers. The consumers' demographic characteristics, attitudes and perceptions toward GM foods as well as the individual choice environment are adopted as the main factors that are postulated to influence consumer information search behaviour about the health, environmental and GM attributes of the bread product. Various binary logit models are estimated for each of the dependent variables of information access, indicating whether or not respondents accessed different types of information made available to them relative to the attributes of the product. These models assess the influence of specified socio-economic, attitudinal and perceptional variables hypothesised as measures of benefits and costs of information search. Overall, the respondents from this survey were not fully informed about GM foods (only 33% of the sample population correctly answered all of the six questions relating to GM technology) and are not all motivated to search for any of the product-related information provided (the descriptive statistics results obtained in Chapter Four show that 36% of the respondents accessed the environmental attribute information, 31% searched for the health information and 24.7% clicked the hyperlinks for information about the GM attribute of the product). This result is consistent with the findings by Noussair on consumers' awareness and purchase behaviour regarding genetically modified food, which suggests that consumers care about and even hold a hostile attitude toward GM products, but they tended not to read the information offered on the labels (Noussair et al.,

2002). A somewhat higher proportion of the respondents sought information on the environmental attribute than on either the health or GM attribute of the product.

The respondents who sought information showed some heterogeneity in their information search. Gender, employment status, rural or urban residency, and the number of children in the household are factors found to have a significant effect on the probability that respondents would access information on particular topics. Female respondents, not working outside the home, without children in the household, and living in urban areas are the major socio-demographic characteristics of people who voluntarily accessed information on the product. The fact that females were more likely to search for information is consistent with our prior hypothesis that females are more inclined to search information than are males (Avery, 1996) and women in general are more concerned with food safety (Li et al., 2002). Respondents who are working in full or part time employment are less likely to access information than those who may have more spare time, like students, homemakers and the retired, which is compatible with the hypothesis of a negative relationship between search and employment status, as has been found or suggested in some other studies (Punj and Staelin, 1983; Srinivasan, 1986; Urbany, 1986). Possible reasons for people with no children in the household tending to seek information might be that this group of people is more interested in this topic or they have more time available with fewer children to care for. The tendency for people living in urban areas to seek information relative to those in rural area might be related to the effectiveness with which news spreads. It may be easier for urban people to obtain information from broadcasts, newspapers, internet, seminars, advertising, and even conversations with friends, leading to their interest in voluntary information search. Other

factors, like age, education, income, residence of province, were not significant explanators of information search, suggesting that consumer information search is not related to these demographic factors in the context of this study.

Generally speaking, people's responses to information seeking in terms of their attitudinal and perceptional characteristics were consistent with what we expected. It is hypothesised in the theoretical analysis that perceptions of risk may have a positive relationship with consumer information search behaviour. When people perceive a risk, they put more effort into seeking information, which may reduce the uncertainty associated with the risk. In this study, respondents' perception of risk on food safety and health issues is adopted to proxy consumers' risk perception of GM food. A significant positive relationship is seen between respondents' perception of risk and their information search about the environmental attribute. That is, respondents who viewed a high level of risk on possible food safety and health issues showed more of a tendency to voluntarily access information about the environmental attribute of the product. However, no significant relationship between respondents' risk perceptions on food safety and health issues and information search is found in respondents' information responses to either the health or GM attribute information.

The descriptive statistics of the trustworthiness respondents assessing for different sources of information are generally consistent with that found in previous studies on the credibility of information sources on GM technology and products. Research institutions and consumers' associations were the two information sources that respondents had assessed as trustworthy sources of information, while the food industry and Canadian Government were ranked on the lower end of trustworthiness as an information source. In

this analysis of the relationship between respondents' views of trustworthiness on information sources and their information search behaviour, the estimated coefficients for trust in most of the cited information sources (Canadian Government, family and friends, farmers' associations, research institutions and consumer associations) are not significant explanators of information search. The only significant correlation between trustworthiness in information source and information search is the significant and negative relationship between respondents' assessment of trustworthiness of the food industry and their information search. Respondents who did not assess the food industry to be a trustworthy information source tended to seek more information.

The estimation results relating consumers' subjective knowledge to information search is significant and positive only in explaining respondents' information search behaviour on the environmental attribute, which shows that if consumers feel that they are well informed on the knowledge of GM technology, they tend to search for more information on the GM-related topics. Moreover, a significant, negative relationship between consumers' positive attitudes toward GM foods and their information search for the environmental attribute is also obtained in this study. It seems that if a consumer fears potential negative effects of GM technology and product on the environment, s/he tends to search more for information pertaining to this aspect, perhaps to clarify these concepts relative to the suspicion in his/her mind.

Another noteworthy finding is that the significant coefficients of attitudinal and perceptional explanatory variables, like perception of risk on safety and health issues, respondents' subjective knowledge and their attitude toward GM products, are only obtained in the model explaining respondents' information search about the

environmental attribute. This suggests that these attitudinal and perceptional characteristics are more influential in respondents' information search about the environmental attribute than on the health and GM attributes.

7.2 Implications of the Findings of the Study

One key finding obtained from this study is that many consumers are not fully informed about GM foods and that many demonstrated little interest in accessing information on the GM-related topics. Perhaps many Canadian consumers are not that interested in this issue, at least in the context of this study. Female respondents, not working outside the home, without children in the household, and living in urban areas are the major socio-demographic characteristics of people who were more likely to access the attribute information in this study, suggesting that this group of consumers may be a target audience for information on GM food issues.

In extending knowledge/information on GM technologies and products, the findings relative to consumers' major characteristics can be taken into consideration. Urban dwellers are more likely to seek information on GM and related food product information. Since "female" and "not employed" are another two characteristics of consumers who may voluntarily seek information on GM related issues, housewives can also be considered as a major recipient group of the population relative to food information and the public places and occasions that they frequently visit, like shopping malls and grocery stores, could be chosen as places to provide information relating to genetic modification and other food attributes. In the context of this study, the demographic factors of education, age, income and province of residence did not account for consumers' information search for food information. Thus, if it is an objective to

consider how information might be made available to consumers, there might be limitations in providing information targeted specifically to consumers with these characteristics.

Although it is possible that consumers' lack of knowledge about GM technology and products and the lack of interest that a majority showed in accessing information on GM-related topics could be an implication of "risk communication failure", this may also just indicate that many Canadian consumers are not that concerned about the topic of GM food—at least as it was presented in this study. Relative to risk communication, Powell and Leiss (1997) suggested that governments and business needed to examine how successful they were in earning the public's trust relative to statements about the risk for which they are responsible, learn to communicate effectively about the scientific basis of those risks, understand the public's framing of risk issues and be completely transparent and comfortable in communicating with the public about risks (Powell and Leiss, 1997). Powell and Leiss also argued that at the level of social discourse, the goal of gradual spread of good risk communication could be achieved by doing the following: "(a) nurture a facility for interpreting risk numbers, including the meaning of risk estimates and the uncertainties associated with them; (b) help people to put the whole assortment of risks affecting them into a broad framework (relative risk, comparative risk); (c) build institutional structures for arriving at a consensus on risk management options, and for allocating risk reduction resources effectively" (Powell and Leiss, 1997)(p.30). In order to reduce the public's distrust in information about GM foods, these authors note that policy makers should bear in mind that the information provided to the public should be

accurate, closely related to consumers' benefits and interests, and that policy making related to the issue should be transparent with the opportunity for public involvement.

Generally speaking, people did not appear to be interested in voluntarily searching for information, which may make it more difficult to provide information to the public. In our discussion of consumer information search behaviour, the analysis of the problem is focused on the benefit-cost structure of this behaviour. Only if the benefits of search outweigh the costs of search, does a consumer perform a search activity. Therefore, the costs of information search must be reduced if people are to be encouraged to access information.

7.3 Limitations and Extensions of the Study

7.3.1 Limitations of this study

An issue we failed to examine is the direct relationship between time availability or time taken and search behaviour, which is a situational constraint that may have an effect on consumers' access to product information (Srinivasan and Ratchford, 1991). (The time the respondents spent to complete the survey questions has not been recorded). Furthermore, we fail to test the effect of consumers' previous experiences of GM products on their information search behaviour. As we discuss in Section 1, Chapter Three, peoples' acquaintance with the product, especially their direct experience from use or consumption of the product, may directly lead to different responses to information. Such data are not directly applicable to the survey and thus are not available. Other limitations include the rather unusual context of a computed based survey, the fact that this was not a "real" purchase decisions, and that in many cases the variables used are proxies for the actual costs and benefits of search. Furthermore, this is a low cost good

with lots of substitutes. People may feel differently about food in general or other food items.

7.3.2 Extensions of this study

Comparing the estimation results from the models explaining consumer information search on different attributes of the product gives a sense of possible internal trade-offs the respondents made when they chose which topics to click the hyperlinks to access information. One component of the results suggests that consumers may evaluate health attribute information to be more valuable or important than environmental or GM information. However, this is a tentative conclusion, based only the choice context estimation results, which is not borne out by the descriptive data analysis or the other regression results. Further research could identify which attributes of the product (either health, environmental or GM attribute) consumers are most concerned about and the possible relationship between consumers' concern and their information search behaviour.

Another issue for further study is how information is processed relative to the effect of information on consumers' preference for the bread product. In the survey, respondents choose one option among the three options provided in a series of choice tasks at the time that they were given the chance to voluntarily access the hyperlinked attribute information on the three attributes of the product. The information provided by different scenarios could vary in content (positive and/or negative) and source (generic or specific). The effects of different information on consumers' purchase decisions for preferred bread products are of interest, and are being assessed in a separate study.

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Appendix 1: Definitions of the demographic variables and related underlying information used to explain specified variables

Variable Name	Definition
Income	Total household income before taxes, measured on an 11-category scale from Less than 10,000 increasing in 10,000 intervals to More than 100,000.
Employment status	Measured on a 3- category scale varying from "Working full- or part-time" to "full- or part-time students" to "Do unpaid work from home/ homemaker" to "retired".
Education	The highest level of education completed, measured on a 10-category scale from "Never attended school" to "Post graduate university degree (e.g., Masters or Ph.D.)".
Internet skill	The internet experience and knowledge level, measured on a 5- category scale from "Expert" to "not at all skilled".
Food safety & health risk	Derived by factor analysis, personal risk perception on different issues relating food safety and health, topics like "bacteria contamination of food", "pesticide residuals in food", "BSE", "fat and cholesterol content", measured on a 4-category scale from "High risk" to "Almost no risk".
Risk in food production	Derived by factor analysis, personal risk perceptions of food risk issues, including use of hormones, antibiotics, food additives and genetic modification, measured on a 4- category scale from "High risk" to "Almost no risk".
Environmental risk	Derived by factor analysis, personal risk perceptions on possible environmental safety issues that might result from modern agriculture, including "Water pollution by chemical run-offs from agriculture", "Soil erosion through agricultural activity", "Genetic modification/ engineering, Resistance to herbicides and pesticides", "Adverse effects of agriculture on biodiversity" and "Agricultural waste disposal (e.g., animal manure)", measured on a 4- category scale from "High risk" to "Almost no risk".
Objective knowledge	A measure of knowledge of GM technology. Respondents were asked to indicate true or false to 6 GM-related statements. The measure is the percentage of correctly answered questions. The statements are: - "Genetic modification/ engineering can only be applied to plants, but not to animals." - "By eating a genetically modified/ engineered food, a person's genes will also become modified." - "Canola, corn, soybean and potato are amongst the genetically modified/ engineered crops currently produced in Canada."

	- "Genetically modified/ engineered food items are currently available in Canadian supermarkets." - "All of the food items in Canadian supermarkets contain genetically modified/ engineered ingredients." - "Canadian food regulations require the labelling of food items which contain genetically modified/ engineered ingredients."
Subjective knowledge	Responses to "How well informed would you say you are about genetically modified/ engineered foods", measured on a 4-category scale from "Very well informed" to "Not at all informed".
Positive or neutral attitude to issues of GM foods	Derived by factor analysis, as a measure of personal attitudes to different issues about applications of genetic modification/ engineering in food production, measured on a 4- category scale from "Strongly agree" to "Strongly disagree". The list of statements are: - "The human health benefits of GM/ GE crops outweigh the human health risks"; - "I would sample foods from GM/ GE crops to find out whether I like them"; - "Foods derived from GM/ GE crops are less risky for humans than foods derived from GM/ GE animals"; - "I would prefer cheaper foods derived from GM/ GE crops over more expensive GM-free products"; - "Canada should advance the general field of GM/ GE technologies to prevent or cure diseases"; - "The overall benefits for the environment of GM/ GE crops outweigh the overall environmental risks"; - "Feeding animals with GM/ GE feed is not a concern"; - "All things considered, benefits of GM/ GE in food production outweigh risks";
Negative attitude to issues of GM foods	Derived by factor analysis, as a measure of personal attitudes on different issues about applications of genetic modification/ engineering in food production, measured on a 4- category scale from "Strongly agree to Strongly disagree". The list of statements are: - "Foods derived from GM/ GE animals are simply not necessary in Canada"; - "Increased GM/ GE crops in Canada will lead to a harmful concentration of corporate power"; - "GM/ GE in agriculture is unnatural"; - "GM/ GE applied to livestock will worsen animal welfare"; - "Overall, I am more sceptical of GM/ GE applications in livestock than in

	stock";
Frequency of discussing GM	The original question asked in the survey is "In the past year, how often have you discussed aspects of genetically modified/ engineered foods with others?", which reported frequency of discussion on aspects of genetically modified/ engineered food, measured on a 3-category scale from "Frequently" to "From time to time" to "Never".
Age	Measured by respondents' reported age.
Gender	Either Male or Female
Number of children in the household	Reported number of children in the family
Urban/Rural	A dummy variable is used for People from urban areas, defined as 1 and for those from rural areas this is defined as 0.
Residence of Provinces	The country is divided into five provincial groups and dummy variables are used: British Columbia is defined as 11, Prairie Provinces (AB, SK, MB) is defined as 12, Ontario is 13, Quebec is 14, and Maritime Provinces (NS, NB, PEI, NF) is 15.
Scenario	A 0-1 dummy variable, showing the complexity of the choice task in the survey. Choice tasks with no information statements are defined as 1 (Scenario 1, in which no information available), and those with information statements varying from two to six are defined as 0 (Scenarios 2-7, in which one or more types of information may be accessed (associated statements may have generic or specific sources and include positive or negative statements but this is not revealed until the information is accessed).

Appendix 2: Description of Variables used in Estimating Models

Variable Name	Variable Description
MALE	A dummy variable representing the gender of the respondent. Where 1 is male and 0 is female.
AGE	A continuous variable representing the age of the respondent.
KIDS	A continuous variable representing the number of children in the household.
UNIV	A dummy variable representing the highest education respondents have finished. Where 1 is university undergraduate degree and above, 0 is the rest.
INCOME	A continuous variable representing the respondents' income before tax, which was derived from the categorical variable in the survey by getting the respective mean of the reported value ranges.

QC	A dummy variable representing the respondent's place of residence. Where 1 is from QC and 0 is from the rest of Canada.
URBAN	A dummy variable representing whether a respondent is from an urban or rural area. Where 1 is from urban area and 0 is from rural area. In this case, we define an urban area as having a population of more than 30,000.
SHRISK	Food safety & health risks, derived from Q6 in the survey Factor Analysis.
FPRISK	Risk brought to food production, the factor scores derived from Q6 in the survey by Factor Analysis.
ENVIRISK	Environmental risks, the factor score derived from Q7 of the survey by Factor Analysis.
KNLDG	A percentage variable representing the respondents' Objective Knowledge on GM technology. To obtain an objective measure of scientific knowledge, respondents were asked to a set of 6 basic questions on information relating to the application of GM technology in food production. The responses to these questions were evaluated and the percentage of correct responses was used as measure of their objective understanding of GM.
HWINFORM	A dummy variable representing respondents' Subjective Knowledge on GM. Where 1 shows a respondent is informed, and 0 is not informed.
ATTITUDE	Respondents' positive & neutral attitude toward application of GM/ GE in food production, the factor scores derived from Question 10 in the survey by Factor Analysis.
NATTITUDE	Respondents' negative attitude toward application of GM/ GE in food production, the factor scores derived from Question 10 in the survey by Factor Analysis.
CANGOV	A dummy variable reflecting the respondent's trust in the Canadian government as a source of trustworthy information about GM/GE food products. Where 1 is that they are a trustworthy source, 0 is that they are not trustworthy.
FDIND	A dummy variable reflecting the respondent's trust in the food industry as a source of trustworthy information about GM/GE food products. Where 1 is that they are a trustworthy source, 0 is that they are not trustworthy.
FMASSO	A dummy variable reflecting the respondent's trust in farmers associations as a source of trustworthy information about GM/GE food products. Where 1 is that they are a trustworthy source, 0 is that they are not trustworthy.
FMLFRD	A dummy variable reflecting the respondent's trust in family and friends as sources of trustworthy information about GM/GE food products. Where 1 is that they are a trustworthy source, 0 is that they are not trustworthy.
RSCHINS	A dummy variable reflecting the respondent's trust in research institutions as a source of trustworthy information about GM/GE food products. Where 1 is that

	they are a trustworthy source, 0 is that they are not trustworthy.
CONSASSO	A dummy variable reflecting the respondent's trust in consumer associations as a source of trustworthy information about GM/GE food products. Where 1 is that they are a trustworthy source, 0 is that they are not trustworthy.

Appendix 3.1: The Chi-squared test results for the statistical significance of the proportions used in Figure 4-1 to Figure 4-6, Figure 4-8 and Figure 4-17.

	Degree of Freedom	chi-square
Figure 4-1:		
bacteria contamination	2	11.567
pesticide residuals	2	9.717
use of hormones	2	14.424
use of antibiotics	2	14.778
mad cow disease	2	49.728
food additives	2	36.62
use of GM/GE	2	52.57
fat and cholesterol	2	10.828
Figure 4-2:		
water pollution	2	70.693
soil erosion	2	11.458
GM/GE	2	24.769
resistance to herbicides and pesticides	2	36.156
adverse effects on biodiversity	2	9.305
waste disposal	2	17.572
Figure 4-3:		
objective knowledge	2	103.21
Figure 4-4:		
subjective knowledge	2	155.006
Figure 4-5:		
"The human health benefits of GM/GE crops outweigh the human health risks."	2	77.315
"I would sample foods from GM/GE crops to find out whether I like them."	2	9.635
"Foods derived from GM/GE crops are less risky for humans than foods from GM/GE animals."	2	141.518
"I would prefer cheaper foods from GM/GE crops over more expensive GM-free products."	2	63.82
"Canada should advance the general field of GM/GE technologies to prevent or cure diseases."	2	3.025

"The overall benefits for the environment of GM/GE crops outweigh the overall environmental risks."	2	70.724
"Feeding animals with GM/GE feed is not a concern."	2	87.891
"All things considered, benefits of GM/GE in food production outweigh risks."	2	68.133

Figure 4-6:	Degree of Freedom	chi-square
"Foods derived from GM/GE animals are simply not necessary in Canada."	2	50.77
"Increased GM/GE crops in Canada will lead to a harmful concentration of corporate power."	2	76.968
"GM/GE in agriculture is unnatural."	2	23.426
"GM/GE applied to livestock will worsen animal welfare."	2	81.251
"Overall, I am more sceptical of GM/GE applications in livestock than in crops."	2	15.668

Figure 4-8:		
Canadian government	2	14.244
food industry	2	44.306
farmer's associations	2	16.562
family/friends	2	24.417
research institutions	2	75.191
consumer associations	2	57.972

Figure 4-17:		
BC	2	252.836
AB, SK, MB	2	133.489
ON	2	53.044
QC	2	129.057
NA, NB, NF, PEI	2	215.07

(A 0.05 level of significance is chosen and the critical value of chi-square with 2 degree of freedom is 5.99.)

Appendix 3.2 The Chi-squared test results for the statistical significance of the proportions in Figure 4-9 to 4-16 by SPSS.

		health information	environmental information	GM information
Gender	Chi-square	14.029	16.9	14.546
	Degrees of Freedom	1	1	1
	Asymp. Sig.	0	0	0
Age	Chi-square	6.0149	3.574	4.167
	Degrees of Freedom	2	2	2
	Asymp. Sig.	0	0	0
Education level	Chi-square	56	64	40
	Degrees of Freedom	1	1	1
	Asymp. Sig.	0	0	0
Income	Chi-square	19.588	21.395	22.894
	Degrees of Freedom	2	2	2
	Asymp. Sig.	0	0	0
No. of children	Chi-square	37	45	33
	Degrees of Freedom	1	1	1
	Asymp. Sig.	0	0	0
Employment status	Chi-square	72	86	57
	Degrees of Freedom	1	1	1
	Asymp. Sig.	0	0	0
Language	Chi-square	29.681	46.225	30.582
	Degrees of Freedom	1	1	1
	Asymp. Sig.	0	0	0
Place of residence	Chi-square	93	106	75
	Degrees of Freedom	1	1	1
	Asymp. Sig.	0	0	0

Appendix 4: The number and percentages of respondents accessing information if they perceived the health and food safety issues to be risky

	Any health information		Any environmental information		Any GM information	
	Number	Percentage	Number	Percentage	Number	percentage
Bacteria contamination	94	32%	109	37%	71	24%
Pesticide residuals	104	33%	120	38%	86	27%
Use of hormones	96	33%	117	40%	74	25%
Use of antibiotics	94	33%	116	40%	74	26%
Mad cow disease	65	33%	69	35%	46	23%
Food additives	84	37%	100	44%	71	31%
Use of GM/GE	66	33%	82	40%	50	25%
Fat and cholesterol	90	31%	114	39%	78	27%

Appendix 5: The number and percentages of respondents accessing information if they perceived the environmental safety issues to be risky

	Any health information		Any environmental information		Any GM information	
	Number	Percentage	Number	Percentage	Number	percentage
Water pollution	128	32%	147	36%	100	25%
Soil erosion	98	33%	113	38%	75	25%
GM/GE	90	35%	105	41%	64	25%
Resistance to herbicides and pesticides	122	33%	134	36%	97	26%
Adverse effects on biodiversity	95	33%	108	37%	75	26%
Waste disposal	110	32%	126	37%	90	26%

Appendix 6: The number and percentages of respondents accessing information if they held positive and neutral attitudes toward GM/GE

Positive statements of the application of GM in food production	Any health information		Any environmental information		Any GM information	
	Number	Percentage	Number	Percentage	Number	percentage
"The human health benefits of GM/GE crops outweigh the human health risks."	40	28%	43	30%	30	20.80%
"I would sample foods from GM/GE crops to find out whether I like them."	64	26%	73	29%	64	25.70%
"Foods derived from GM/GE crops are less risky for humans than foods from GM/GE animals."	30	31%	34	35%	27	27.60%
"I would prefer cheaper foods from GM/GE crops over more expensive GM-free products."	33	23%	36	25%	29	20.30%
"Canada should advance the general field of GM/GE technologies to prevent or cure diseases."	88	30%	99	34%	80	27.20%
"The overall benefits for the environment of GM/GE crops outweigh the overall environmental risks."	37	26%	40	28%	32	22.20%
"Feeding animals with GM/GE feed is not a concern."	40	28%	49	34%	31	21.70%
"All things considered, benefits of GM/GE in food production outweigh risks."	46	28%	54	33%	41	25.30%

Appendix 7: The number and percentages of respondents accessing information if they held a negative attitudes toward GM/GE

Negative statements of the application of GM in food production	Any health information		Any environmental information		Any GM information	
	Number	Percentage	Number	Percentage	Number	percentage
"Foods derived from GM/GE animals are simply not necessary in Canada."	72	35%	85	41%	53	26%
"Increased GM/GE crops in Canada will lead to a harmful concentration of corporate power."	65	34%	81	43%	40	24%
"GM/GE in agriculture is unnatural."	83	34%	92	38%	63	26%
"GM/GE applied to livestock will worsen animal welfare."	56	33%	68	40%	41	24%
"Overall, I am more skeptical of GM/GE applications in livestock than in crops."	68	29%	76	32%	61	26%

Appendix 8: The number and percentages of respondents accessing information if they evaluated the information sources to be trustworthy

The information sources	Any health information		Any environmental information		Any GM information	
	Number	Percentage	Number	Percentage	Number	percentage
Canadian government	82	31%	94	36%	63	24%
The food industry	48	26%	55	30%	39	21%
Farmers' associations	75	28%	95	35%	57	21%
Family/friends	69	30%	80	35%	56	24%
Research institutions	127	31%	148	36%	99	24%
Consumer associations	122	31%	139	35%	101	25%

Appendix 9: The number and percentage of respondents accessing different types of information sorted by individuals' demographic characteristics

Variable name		Total		Any health Attribute		Any environmental attribute		Any GM Attribute	
		Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage
Gender	Male	181	41%	47	34%	54	34%	35	32%
	Female	263	59%	91	66%	106	66%	75	68%
Age	19-37 yr	143	32%	34	25%	43	28%	31	29%
	38-54 yr	155	36%	43	32%	50	32%	31	29%
	55-79 yr	131	31%	57	43%	62	40%	46	43%
Education Level	Below university grad.	282	64%	81	59%	95	59%	70	64%
	university and above	161	36%	57	41%	65	41%	40	36%
Income	less than 10,000~29,999	68	19%	22	22%	24	20%	16	19%
	30,000~79,999	187	53%	55	54%	63	53%	49	58%
	80,000 and above	100	28%	25	24%	32	27%	20	23%
Number of Children	None	258	58%	188	73%	186	72%	181	70%
	1~6	180	41%	49	27%	50	28%	54	30%
Employment status	Working full- or part- time	272	43%	73	27%	87	32%	57	21%
	Students, house makers & retired	157	54%	63	40%	50	32%	52	33%
Language	English-speaking	343	77%	99	29%	123	36%	82	24%
	French-speaking	102	23%	38	37%	38	37%	27	26%
Rural or Urban	Rural	160	36%	41	31%	49	32%	33	31%
	Urban	280	64%	93	69%	106	68%	75	69%
Province of residence	BC	51	11%	17	33%	24	47%	10	20%
	AB, SK, MB	55	12%	10	18%	13	24%	12	22%
	ON	192	43%	62	32%	73	38%	53	28%
	QC	113	26%	39	35%	39	35%	28	25%
	NS, NB, NF, PEI	33	8%	10	30%	11	35%	7	21%

Appendix 10: University of Alberta GM foods survey questionnaire

University of Alberta GM Foods Discrete Choice Study (06-3821-01 #9997) FINAL: December 5, 2002

Introduction at Site

Welcome!

Thanks again for agreeing to take part in this research.

As you go through the survey, please take time to answer each question, as you can only move from one page to the next after answering all questions. **To go forward or backward, please use the next page/pervious page buttons at the bottom of each page, NOT the Forward/Back button on your browser.**

There are two parts to this survey – a purchase simulation and a questionnaire. **We ask that you complete all parts of the purchase simulation in one session.** If at any time after that you wish to stop the questionnaire and complete it at a later time, please click on the Stop button located at the bottom of the questionnaire, and come back to it at your convenience. When you return to the survey site you will be required to enter your PIN and the questionnaire will begin again where you left off.

[Screener]

S1. Which of the following types of bread do you ever purchase? **CHECK ALL THAT APPLY**

Sliced, pre-packaged store brand
Sliced, pre-packaged national brand
Fresh bakery bread
Make my own
Never buy bread
DK/NS

CONTINUE IF SLICED PRE-PACKAGED STORE BRAND AND/OR SLICED PRE-PACKAGED NATIONAL BRAND, ALL OTHERS THANK & TERMINATE

In this survey, we are interested in your choices of pre-packaged sliced loaf bread that you typically buy at the grocery store. By "sliced loaf bread" we mean the bread that is often purchased for breakfast or sandwiches, like the breads shown in the picture below. We will ask you questions about your preferred bread choices, and your opinions about your bread's nutrition contents and health aspects.

[QUESTIONNAIRE]

[Your Typical Bread Purchase]

Q1. We would like to start this survey by learning more about pre-packaged bread that you normally buy in the grocery store. Please tell us about your **typical bread purchase**. Assume that the bread you buy is **fresh** and **well presented** (i.e. no damaged slices, packaging, etc.).

We understand that you might purchase a variety of different types of bread at different times. However, for the purpose of this study, please indicate which characteristic you **most often** select for each feature of loaf bread presented below [i.e., brand, type of flour, loaf consistency, price, thickness of slices and shape] when purchasing bread.

a) **BRAND: I <u>most often</u> purchase... CHECK ONE ONLY**

National brand [sliced, pre-packaged, for example, Dempster's, Wonderbread, Ovenjoy, Olafson, Healthy Way, etc.]

Store brand [sliced, pre-packaged, for example, President's Choice, Western Family, Safeway, IGA, etc.]

b) **PRICE: I <u>most often</u> purchase... CHECK ONE ONLY**

$0.99 / 600g loaf
$1.00 to $1.99 / 600g loaf
$2.00 to $2.99 / 600g loaf
$3.00 to $3.99 / 600g loaf
$4.00 or more / 600g loaf

c) **TYPE OF FLOUR: I <u>most often</u> purchase... CHECK ONE ONLY**

White
Partly whole wheat [60%]
Whole wheat [100%]
Multigrain

d) **LOAF CONSISTENCY: I <u>most often</u> purchase... CHECK ONE ONLY**

Dense loaf consistency
Soft loaf consistency

e) **BREAD CRUST: I <u>most often</u> purchase... CHECK ONE ONLY**

Light brown, soft crust
Mid brown, crunchy crust

f) **THICKNESS OF SLICES: I <u>most often</u> purchase... CHECK ONE ONLY**

Regular slices
Thick slices

g) **SHAPE OF SLICES: I <u>most often</u> purchase... CHECK ONE ONLY**

Sandwich loaf, square slices
Rounded-top slices

Q2. a) For the following question, even if you are not sure of the answer, we are interested in your <u>perceptions</u> of the bread you most often buy. Based on what you know or what you think, is the bread you **most often** buy ... **[RANDOMIZE ORDER OF PRESENTATION]**

Yes
No
DK/NS

a) Low in fat
b) High in nutrition
c) High in fibre
d) Low in sodium

e) Organic
f) Free of genetically modified/engineered ingredients
g) Free of pesticide residues

ASK Q2b FOR ALL ITEMS DK/NS IN Q2a

b) We understand that you are not sure about whether the bread you buy has these characteristics. However, we would like you to choose a "yes" or "no" based on your perceptions or what you think is most likely. Do you think the bread you most often buy is.....

Probably Yes
Probably No

POSSIBLE ITEMS [INSERT ALL DK/NS FROM Q2a]

a) Low in fat
b) High in nutrition
c) High in fibre
d) Low in sodium
e) Organic
f) Free of genetically modified/engineered ingredients
g) Free of pesticide residues

Q3. How important are the following pre-packaged sliced bread features to you when choosing a loaf of sliced bread to buy in the grocery store?

Very important
Somewhat important
Not very important
Not at all important
DK/NS

a) Brand name
b) Type of bread (e.g., white, whole wheat, multigrain)
c) Price of bread

NOTE TO SCRIPTWRITER: SAMPLE IS SPLIT BETWEEN PURCHASE SIMULATION 1 AND PURCHASE SIMULATION 2

[PURCHASE SIMULATION 1]

PLEASE TAKE TIME TO CAREFULLY READ THE FOLLOWING INSTRUCTIONS BEFORE PROCEEDING

In this section you will be presented with a series of purchase options for pre-packaged bread. Each option will include a description of different features. For each purchase simulation, you will be asked to indicate your preferred choice.

FOR EACH SCENARIO, please imagine you are planning to purchase pre-packaged bread. You will have a number of different options presented to you on the following screens.

- **Please choose ONLY ONE OPTION on each screen**
- **Assume that the options on EACH SCREEN are the ONLY ones available**
- **DO NOT COMPARE OPTIONS ON DIFFERENT SCREENS**

You may encounter a few options that seem counter-intuitive (e.g. a lower price but a higher number of features). Be assured that **this is not an error** but part of the design of the survey. Simply choose the one bread option that you prefer most based on its characteristics.

Q4. Now suppose you are shopping for sliced bread. The following choices are the ONLY ONES AVAILABLE to you in the grocery store. Again, the bread you buy is FRESH and WELL PRESENTED (i.e. no damaged slices, packaging, etc.)

Please examine each choice below, keeping in mind that, in a real-life-situation, you are paying for the product that you choose. Please choose ONE AND ONLY ONE of Option A, Option B or Option C. Please make the choice that closely reflects your real decision.

I would purchase...

Option A
Option B
Option C

PRIOR TO BEGINNING PURCHASE SCENARIOS, RANDOMLY ASSIGN EACH RESPONDENT ONE OF THE FOLLOWING INFORMATION SCENARIOS:

INFO SCENARIO 1: NO INFORMATION STATEMENT

INFO SCENARIO 2:

-WHEN RESPONDENT CLICKS ON 'To find out whether genetically modified/engineered foods are safe to eat, please click here' THIS BOX OPENS IN A SEPARATE WINDOW

Proponents of genetically modified/ engineered foods assert that genetically modified/ engineered foods are safe to eat. The government regulates biotechnology, including genetic modification/ engineering, with the same rigor as is applied to safeguard all foods in the marketplace. The nutrition and safety of each product is evaluated at many stages before it reaches the consumer. Research shows that foods derived through biotechnology are as safe to eat as traditional foods. Foods enhanced by biotechnology are evaluated for safety according to processes endorsed by the United Nations Food and Agriculture Organization and the World Health Organization. Reviews by nutrition and dietetic experts, such as the American Dietetic Association, have concluded that "foods produced using biotechnology are as safe as traditional foods".

-WHEN RESPONDENT CLICKS ON 'To find about environmental effects of genetically modified wheat, please click here' THIS BOX OPENS IN A SEPARATE WINDOW

Proponents of genetically modified/ engineered foods assert that biotechnology, including genetic modification/ engineering, benefits the environment in several ways. Wheat can be produced with fewer pesticides while increasing a crop's own ability to fight pests and diseases. These new crops encourage farming techniques that preserve precious topsoil, reduce soil erosion and runoff into streams and rivers, and even reduce greenhouse gas emissions. Before any new genetically modified wheat is brought to market, it is thoroughly evaluated for environmental safety, on a case-by-case basis, by government regulators.

INFO SCENARIO 3:

-WHEN RESPONDENT CLICKS ON 'To find out whether genetically modified/engineered foods are safe to eat, please click here' THIS BOX OPENS IN A SEPARATE WINDOW

Critics of genetically modified/ engineered foods caution that the unpredictable nature of the genetic engineering process, and our inability to control genetic modification in our foods create unacceptable health risks. Genetic modification/ engineering may affect food safety because (i) gene disruption or instability may lead to new toxins being produced and / or (ii) the new protein produced by the foreign gene may cause allergies or toxicities. GM/ GE crops have been approved by the Canadian government without adequate testing for health safety.

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Critics of genetically modified/ engineered foods caution that the environmental risks of genetic modification/ engineering may include the development of super-weeds and super pests, cross-breeding with wild plants and conventional crops, harm to insects and animals, and loss of bio-diversity. Genetic modification/ engineering can have unexpected and unintended effects because the process is imprecise and random. Inserted genes may disrupt natural genes, be unstable in their new environment, or function differently than expected.

INFO SCENARIO 4:

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INFO SCENARIO 5:

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INFO SCENARIO 6:

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Greenpeace cautions that the unpredictable nature of the genetic engineering process, and our inability to control genetic modification in our foods create unacceptable health risks. Genetic modification/ engineering may affect food safety because (i) gene disruption or instability may lead to new toxins being produced and / or (ii) the new protein produced by the foreign gene may cause allergies or toxicities. GM/ GE crops have been approved by the Canadian government without adequate testing for health safety.

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SCRIPTER NOTE: This is an example only. The number of choice sets will be determined by the choice design

FEATURES	Option A	Option B	Option C
Brand	Insert response from Q1a	Insert response from Q1a	I would not buy any bread at all
Type of Flour	Insert response from Q1c	Insert response from Q1c	
Loaf Consistency	Insert response from Q1d	Insert response from Q1d	
Thickness of Slices	Insert response from Q1f	Insert response from Q1f	
Bread Crust	Insert response from Q1e	Insert response from Q1e	
Shape of Slices	Insert response from Q1g	Insert response from Q1g	
Price [Before applying price variation, part of DC design]	-If $0.99 selected in Q1b, insert $0.99 / 600g loaf -If $1.00 to $1.99 selected in Q1b, insert $1.49 / 600g loaf -If $2.00 to $2.99 selected in Q1b, insert $2.49 / 600g loaf -If $3.00 to $3.99 selected in Q1b, insert $3.49 / 600g loaf -If $4.00 or more selected in Q1b, insert $4.49 / 600g loaf	-If $0.99 selected in Q1b, insert $0.99 / 600g loaf -If $1.00 to $1.99 selected in Q1b, insert $1.49 / 600g loaf -If $2.00 to $2.99 selected in Q1b, insert $2.49 / 600g loaf -If $3.00 to $3.99 selected in Q1b, insert $3.49 / 600g loaf -If $4.00 or more selected in Q1b, insert $4.49 / 600g loaf	
		Rich in healthy vitamins *	
		Produced environmentally friendly *	

IF 'HEALTH ATTRIBUTE' <u>PRESENT</u> IN DC DESIGN, Rich in healthy vitamins* APPEARS IN OPTION B
IF 'ENVIRONMENTAL ATTRIBUTE' <u>PRESENT</u> IN DC DESIGN, Produced environmentally friendly* APPEARS IN OPTION B

IF 'GMO' PRESENT IN DC DESIGN AND HEALTH ATTRIBUTE OR ENVIRONMENTAL ATTRIBUTE PRESENT IN DC DESIGN, THE BOX BELOW APPEARS BELOW THE CHOICE GRID:

More on the new feature(s) of this bread:

* [redacted] additional features are a result of genetic modification/engineering of the wheat.

Genetic modification, sometimes also called genetic engineering, is a recent development in modern biotechnology. This technique involves the transfer of a piece of genetic material from one organism to another. Through genetic engineering it is easier to introduce new traits without changing other traits in the plant or animal. It is also possible to introduce traits from outside the species, something that is not possible with traditional breeding methods.

IF 'GMO' PRESENT IN DC DESIGN BUT BOTH HEALTH ATTRIBUTE AND ENVIRONMENTAL ATTRIBUTE ABSENT IN DC DESIGN, THE BOX BELOW APPEARS BELOW THE CHOICE GRID:

[redacted] is made with genetically modified/engineered wheat.

Genetic modification, sometimes also called genetic engineering, is a recent development in modern biotechnology. This technique involves the transfer of a piece of genetic material from one organism to another. Through genetic engineering it is easier to introduce new traits without changing other traits in the plant or animal. It is also possible to introduce traits from outside the species, something that is not possible with traditional breeding methods.

ANOTHER BOX WITH HYPERLINKS APPEARS BELOW GRID; CONTENTS BASED ON DC DESIGN

IF 'GMO' PRESENT IN DC DESIGN AND SCENARIO 2 TO 6 [NO LINKS IF SCENARIO 1]

-To find out whether genetically modified/engineered foods are safe to eat, please click here

-To find about environmental effects of genetically modified crops, please click here

IF 'HEALTH ATTRIBUTE' PRESENT IN DC DESIGN:

-To find out more about the vitamins in this bread, please click here

-To learn why vitamins are important, please click here

IF 'ENVIRONMENTAL ATTRIBUTE' PRESENT IN DC DESIGN:

-To find out why this product is environmentally friendly, please click here

-Why is reducing herbicides in agriculture important? Please click here

EXAMPLE IF ALL ATTRIBUTES ARE PRESENT IN DC DESIGN

To find out whether genetically modified/engineered foods are safe to eat, please click here To find about environmental effects of genetically modified crops, please click here To find out more about the vitamins in this bread, please click here To learn why vitamins are important, please click here To find out why this product is environmentally friendly, please click here Why is reducing herbicides in agriculture important? Please click here

THE HYPERLINKS WITHIN THIS INFORMATION BOX SHOULD RESULT IN A SEPARATE WINDOW OPENING WITH THE APPROPRIATE INFORMATION. We will need to set up to track window open requests.

To find out whether genetically modified/engineered foods are safe to eat, please click here
To find about environmental effects of genetically modified crops, please click here

REFER TO SCENARIOS

To find out more about the vitamins in this bread, please click here

The wheat used for this bread is rich in the nutrients vitamin C, vitamin E, selenium, and beta-carotenes. These nutrients are also contained in many fruits and vegetables.

To learn why vitamins are important, please click here

Amongst other important functions in the body, these nutrients may protect body cells from damage. This helps to keep the immune system healthy and may reduce your risk for cancer and other diseases. The nutrients contained in this wheat survive the baking process well. Thus, this bread may help preventing a variety of diseases such as colon cancer, heart disease and diabetes.

To find out why this product is environmentally friendly, please click here

The farmers who produce this wheat can reduce the total amount of herbicides applied and replace commonly used chemical products that have unfavourable environmental effects.

This is possible because farmers can use one specific herbicide after the wheat has been planted. In turn, less herbicide sprayings are necessary. Also, the use of this specific herbicide reduces tillage and reduces soil erosion. This contributes to protecting the environment.

Why is reducing herbicides in agriculture important? Please click here
Residuals from agricultural chemicals, such as herbicides, may not fully be used by the plants. Consequently, they may contribute to the pollution of surface and ground water. Thus, reducing the use of chemicals in agricultural production contributes to keeping water resources cleaner.

[PURCHASE SIMULATION 2]

PLEASE TAKE TIME TO CAREFULLY READ THE FOLLOWING INSTRUCTIONS BEFORE PROCEEDING

In this section you will be presented with a series of purchase options for pre-packaged bread. Each option will include a description of different features. For each purchase simulation, you will be asked to indicate your preferred choice

FOR EACH SCENARIO please imagine that you are planning to purchase pre-packaged bread. You will have a number of different options presented to you on the following screens.

- **Please choose ONLY ONE OPTION on each screen**
- **Assume that the options on EACH SCREEN are the ONLY ones available**
- **DO NOT COMPARE OPTIONS ON DIFFERENT SCREENS**

You may encounter a few options that seem counter-intuitive (e.g. a lower price but a higher quality in your personal opinion). Be assured that **this is not an error** but part of the design of the survey. Simply choose the one bread option that you prefer most based on its characteristics.

Q5. Now suppose you are shopping for sliced bread. The following choices are the ONLY ONES AVAILABLE to you in the grocery store. Again, the bread you buy is FRESH and WELL PRESENTED (i.e. no damaged slices, packaging, etc.).

Please examine each choice below, keeping in mind that, in a real-life-situation, you are paying for the product that you choose. Please choose ONE AND ONLY ONE of Option A, Option B or Option C. Please make the choice that closely reflects your real decision.

I would purchase...

Option A
Option B
Option C

EXAMPLE ONLY Case 1

Features	Option A	Option B	Option C
Brand Name	National brand (such as "Old Mill" and "Wonder")	Store brand (such as Safeway and IGA brands)	I would not buy any bread at all
Type of Bread	100% whole wheat	60% whole wheat	
Ingredients	Wheat flour, water, yeast, vegetable oil, sugar, salt Contains genetically modified/engineered ingredients.	Wheat flour, water, yeast, vegetable oil, sugar, salt.	
Price	$1.49	$2.49	

[Consumer Attitudes Towards GM/ GE Ingredients in Food Products]

Q6. Below is a list of possible food safety issues. For each, please indicate how much of a health risk you feel *it is to you personally*. **[RANDOMIZE ORDER OF PRESENTATION]**

High risk
Moderate risk
Slight risk
Almost no risk
DK/NS

a) Bacteria contamination of food
b) Pesticide residuals in foods
c) Use of hormones in food production
d) Use of antibiotics in food production
e) BSE (mad cow disease)
f) Use of food additives
g) Use of genetic modification / engineering in food production
h) Fat and cholesterol content

Q7. We would like to get your opinion on possible environmental safety issues that might result from modern agriculture. Please indicate how much of a risk you personally believe each issue represents. **[RANDOMIZE ORDER OF PRESENTATION]**

High risk
Moderate risk
Slight risk
Almost no risk
DK/NS

a) Water pollution by chemical run-offs from agriculture
b) Soil erosion through agricultural activity
c) Genetic modification / engineering
d) Resistance to herbicides and pesticides
e) Adverse effects of agriculture on biodiversity
f) Agricultural waste disposal (e.g., animal manure)

[Knowledge About Genetic Modification / Engineering in Food Products]

Q8. We will now ask you several questions about the technology that is referred to as *"genetic modification (GM)" or "genetic engineering (GE)"*. We appreciate your answers as they help us to better understand how familiar the public is with this topic.

For each of the following statements please indicate whether you believe the statement is *"true"*, *"false"* or that you *"don't know"*. **[RANDOMIZE ORDER OF PRESENTATION]**

True
False
DK/NS

a) Genetic modification/ engineering can only be applied to plants, but not to animals.
b) By eating a genetically modified/ engineered food, a person's genes will also become modified.
c) Canola, corn, soybean and potato are amongst the genetically modified/ engineered crops currently produced in Canada.
d) Genetically modified/ engineered food items are currently available in Canadian supermarkets.
e) All of the food items in Canadian supermarkets contain genetically modified/ engineered ingredients.

f) Canadian food regulations require the labelling of food items which contain genetically modified/ engineered ingredients.

Q9. How well informed would you say you are about genetically modified/ engineered foods? Would you say…?

Very well informed
Somewhat informed
Not very informed
Not at all informed
DK/NS

[Potential Benefits and Risks of GM Foods]

Q10. We would like to get your opinion on issues about applications of genetic modification/ engineering (*GM/ GE) **in food production***. Following is a list of opinion statements. The statements refer to GM/ GE foods derived from ***animals*** (such as meat, dairy products, milk, eggs, etc.) as well as derived from crops (grains, oils seeds, etc). In the statements below, we will treat these distinctions as two separate issues.

Please read each statement carefully and indicate your agreement or disagreement with the statement. **[RANDOMIZE ORDER OF PRESENTATION]**

Strongly agree
Somewhat agree
Somewhat disagree
Strongly disagree
DK/NS

a) The human health benefits of GM/ GE crops outweigh the human health risks.
b) I would sample foods from GM/ GE crops to find out whether I like them.
c) Foods derived from GM/ GE animals are simply not necessary in Canada.
d) Foods derived from GM/ GE crops are less risky for humans than foods derived from GM/ GE animals.
e) I would prefer cheaper foods derived from GM/ GE crops over more expensive GM-free products.
f) Canada should advance the general field of GM/ GE technologies to prevent or cure diseases.
g) The overall benefits for the environment of GM/ GE crops outweigh the overall environmental risks.
h) Increased GM/ GE crops in Canada will lead to a harmful concentration of corporate power.
i) GM/ GE in agriculture is unnatural.
j) GM/ GE applied to livestock will worsen animal welfare.
k) Overall, I am more sceptical of GM/ GE applications in livestock than in crops.

l) Feeding animals with GM/ GE feed is not a concern.
m) All things considered, benefits of GM/ GE in food production outweigh risks.

[Sources of Information About GM Food Products]

Q11. In the past year, how often have you discussed aspects of genetically modified / engineered foods with others? Would you say.... **CHECK ONE RESPONSE ONLY**

Frequently
From time to time
Never
DK/NS

Q12. Suppose you wanted to obtain trustworthy information about genetically modified/ engineered food products. Please indicate how trustworthy you consider each of the following sources to be.
[RANDOMIZE ORDER OF PRESENTATION]

Very trustworthy
Somewhat trustworthy
Not very trustworthy
Not at all trustworthy
DK/NS

a) Canadian Government
b) The food industry
c) Farmers' associations
d) Family / friends
e) Research institutions (e.g., universities)
f) Consumer associations

Q13. We would like to gain an understanding about your actions with respect to GM food products. Please check either "Yes" or "No" for each of the following statements.
[RANDOMIZE ORDER OF PRESENTATION]

Yes
No
DK/NS

a) The possibility of genetically modified/ engineered content affects my food choices.
b) I purposefully buy food at organic stores to avoid genetically modified/ engineered foods.
c) I donate money to organizations which oppose genetically modified/ engineered foods.
d) I donate money to environmental protection organizations.
e) I have lobbied against genetically modified/ engineered foods.

[Labelling Of GM Foods]

Q14. The following statements concern your opinion regarding the regulation of genetically modified/ engineered foods. Currently, discussions are going on in Canada as to whether or not food that contains genetically modified/ engineered ingredients should be labelled. Food labelling can be either mandatory or voluntary.

Mandatory labelling requires all producers to clearly and prominently label any product that contains genetically modified/ engineered ingredients. Under a voluntary labelling scheme, producers can choose to label or not to label products that contain genetically modified/ engineered ingredients as long as the information they provided is true, and not misleading or deceptive.

Please indicate your level of agreement or disagreement with each of the following statements. **[RANDOMIZE ORDER OF PRESENTATION]**

Strongly agree
Somewhat agree
Somewhat disagree
Strongly disagree
DK/NS

a) The public is sufficiently involved in the regulation of genetically modified/ engineered foods.
b) Even if food prices were higher, the consumers' "right to know" warrants a mandatory labelling scheme.
c) The decision about introduction of genetically modified/ engineered foods to Canada should be left to experts.
d) There is no need for mandatory labelling of genetically modified/ engineered foods if the final product quality is the same.
e) Voluntary labelling might be used as a marketing tool rather than providing useful consumer information.
f) Stricter regulations for approving genetically modified/ engineered foods are better than a mandatory labelling system for genetically modified/ engineered foods.
g) Overall mandatory labelling is preferable to voluntary labelling.

[Demographic Information]

The following questions are designed to tell us a little about you. This information will only be used to report comparisons among groups of people. Your identity will not be linked to your responses in any way.

Q15. Are you…

Male
Female

Decline to respond

Q16. What is your age?

RECORD NUMBER OF YEARS [**RANGE 18 TO 120**]
Decline to respond

Q17. How many people, including yourself, live in your household?

RECORD NUMBER [**RANGE 1 TO 20**]
Decline to respond

Q18. How many children live in your household?

None
RECORD NUMBER [**RANGE 1 TO 20**]
Decline to respond

ASK Q19 IF ONE OR MORE IN Q18
Q19. And how many children living in your household fall into each of the following age groups?

a) 1 to 4 years
RECORD NUMBER [**RANGE 0 TO 20**]

b) 5 to 11 years
RECORD NUMBER [**RANGE 0 TO 20**]

c) 12 to17 years
RECORD NUMBER [**RANGE 0 TO 20**]

Q20. What is the highest level of education that you have completed? **CHECK ONE ONLY**

Never attended school
Grade school (grades 1 to 9)
Some high school
High school graduate
Post secondary trade or technical school certificate/degree
Some university or college
College diploma/degree
University undergraduate degree
Some post graduate university study
Post graduate university degree (e.g., Masters or Ph.D.)
Decline to respond

Q21. Which of the following best describes your employment status? **PLEASE SELECT ONE ONLY**

Working full- or part-time **[PLEASE SPECIFY OCCUPATION]**
Full- or part-time student
Do unpaid work from home/ homemaker
Retired
Decline to respond

Q22. For classification purposes, what is your total household income before taxes? **CHECK ONE ONLY**

Less than $10,000
$10,000 - $19,999
$20,000 - $29,999
$30,000 - $39,999
$40,000 - $49,999
$50,000 - $59,999
$60,000 - $69,999
$70,000 - $79,999
$80,000 - $89,999
$90,000 - $99,999
More than $100,000
Decline to respond

Q23. How often do you buy organic food products? **CHECK ONE ONLY**

Regularly
Occasionally
Never
DK/NS

Q24. Are you a member of or associated with any consumer group that focuses on issues of food safety?

Yes
No
Decline to respond

Q25. Are you a member of or associated with any environmental group? **CHECK ONE ONLY**

Yes
No
Decline to respond

DELETE THESE PRETEST QUESTIONS [DO NOT REMOVE THE DEBRIEFING SECTION]

[Feedback on the Survey *[QUESTIONS TO BE INCLUDED IN PRETEST ONLY; CAN ALL BE ON ONE SCREEN]*

In the survey that you just completed, we were interested in your bread choices. Below, we ask you some questions pertaining to the survey itself. Your answers will help us improve the survey and make it easier for other respondents to participate.

PT1. How easy or difficult did you find completing the purchase simulation questions? Would you say ...? **CHECK ONE ONLY**

Very easy
Somewhat easy
Somewhat difficult
Very difficult
DK/NS

PT2. Is there anything you would change to make the purchase simulation easier for others?

PT3. What specifically did you like about the survey?

PT4. What specifically did you dislike about the survey?

Participant Debriefing

Dear Survey Participant:

Once again, we would like to take the opportunity to thank you for participating in this survey. Your contribution is much appreciated.

At this point we would also like to explain more about this research. The study is being conducted by the Department of Rural Economy at the University of Alberta in Edmonton, AB. The purpose is to better understand how people view potential risks and benefits of genetically modified/ engineered foods, their likely choices in a purchase context, and the effects of information on choices. The results of this study will be reported in terms of averages only and individual responses will be confidential. The report of these results will be publicly available and may help to improve Canadian food policies.

We point out that at this point in time, genetically modified/ genetically engineered wheat is not approved for use or sale in the Canadian market, and the products suggested in this survey are HYPOTHETICAL products not currently available in the Canadian market. To access the quoted information on possible health and environmental effects by Monsanto and Greenpeace, please click on the following links: ***[LINKS SHOULD OPEN IN A SEPARATE WINDOW]***